THE

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ELECTRICAL REVIEW.

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SOCIAL INSTITUTES FOR WORKMEN.

THE opening of the "Allen Institute," to which we devoted a short paragraph on p. 224 of our issue for August 10th, brings into prominence once again the attempts that are being made by numerous employers to improve the pecuniary, social, and intellectual position of their workmen; and thus it inevitably raises the difficult question whether such attempts actually do an amount of good commensurate with the time and money spent upon them.

The Allen Institute is an enterprise of the type to which we are becoming accustomed, intended for the pleasure and profit of the hands engaged at the Queen's Engineering Works belonging to Messrs. W. H. Allen, Son & Co., of Bedford. The building contains a public hall, reading, smoking, conversation and billiard rooms, rooms for other games, lavatories, a kitchen and the usual offices. It is surrounded with pleasure grounds, where large cycle sheds have been erected. It being situated close to the factory, a very useful feature has been introduced. Before entering the works in the morning, a man can hand his dinner to an attendant, and have it cooked or prepared for him ready to eat at midday in the room that serves for public meetings at night. He can also purchase tea and the like ready to drink —the Institute is, of course, "teetotal"—or make it himself with hot water supplied free. The annual subscription amounts to 4s. per head, a nominal sum considering what it purchases.

If we mistake not, undertakings of the kind described are sometimes started from almost pure commercial reasons, sometimes from almost pure philanthropy, but very often, no doubt, from mixed motives. In the United States, at least, no hesitation is displayed by the initiators in stating that they confidently look forward to an indirect pecuniary return for the money invested, inasmuch as the facilities offered by such institutes for social intercourse and intellectual improvement attract to the service of the company a better class of labour, and one of greater staying power, than would otherwise be the case. In spite of many and repeated disappointments that have been experienced here and there, the general trend of expert opinion appears to be that the system is usually a successful speculation, even if, as follows from the nature of the experiment, a balance-sheet satisfactory to an accountant cannot be drawn up on paper. The man who steals the gun-metal taps from the bath-rooms would in their absence pilfer other articles belonging to his employer; the man who refuses to participate in the advantages of a co-operative kitchen, in spite of the lower prices, better food and attendance, on the ground of "bad cooking," would grumble at anything; so that the baths and kitchen simply afford the employer additional opportunities for detecting and weeding out undesirable hands. But, regarded from this aspect, the provision of a workmen's institute amounts to little more than an indirect payment of extra wages above the market rate to men whose temperament qualifies them to appreciate the

value of the benefits thus offered them. Hence the plan naturally invites a comparison with what is known as co-partnership. The institute system of retained payments avoids any temptation to extravagance on the part of the workman which the periodical handling of small additional sums of money may encourage, whereas the co-partnership system more directly interests him in the success of his factory, inasmuch as the magnitude of his extra payments depends mainly or entirely on the dividend his labour is helping to earn. Only a few days ago, at the meeting of the South Metropolitan Gas Co., Sir George Livesey stated that over £49,000 had been credited to their employés during the past year under the co-partnership system, a sum representing nearly 10 per cent. on the wages and salaries. He added that it was hard to say whether the men were saving an equal amount for the company by their improved working, but the directors "believed there were advantages resulting"—the men being independent, and the company free from any danger of a strike.

But, although the foundation and maintenance of a workmen's institute may well prove advantageous to an individual or multiple employer by bringing into his shops labour of a superior class, and so relieving him from many anxieties; when the scheme is intended (as we believe Messrs. Allen intend it) as a conscientious and most praiseworthy attempt to improve the condition of the working man in general, we feel less confident of its ultimate success. The manifold advantages offered by an institute are only advantages to the man who has learnt to know them as such, and to act according to his knowledge. A place where he can read useful books and enjoy harmless recreation of an evening, without the concomitant of intoxicating liquor, only appeals to the man who goes to the public-house because there is no alternative open to him; and the fact that the institute is usually conducted on strictly "teetotal" lines, with the laudable idea of diminishing drunkenness, lessens its attractiveness to the members of that large, but habitually ignored, class of working men who (like so many of their "social superiors") use their glass of beer as not abusing it. On the other hand, a workmen's institute, strictly non-alcoholic or not, does not offer the least attraction to the man who is a confirmed drunkard or gambler, or is merely a loafer, malingerer, or "land-grabber"—and these are the men, when reclamation is the object, who most require attention.

There is yet another point. When the labour employed by a firm is mainly or entirely masculine, the institute must be so arranged as mainly or entirely to cater for the male sex, and, therefore, it exhibits a very grave defect from the philanthropic standpoint. To a large extent the adult, if not also the adolescent, male is already a crystallised product of his early environment, and as such will either improve himself in the absence of encouragement, or refuse to do so in its presence. If we desire to ameliorate the physical and intellectual conditions of the working man, we must, therefore, lay our plans so as to attract his wife and children; teaching the wife how properly to fulfil the duties which nature has cast upon her as a mother and nurse, securing the babies from the pernicious influence of extreme penury and ignorance of hygiene, guarding them during their most receptive age against the evil example of dissolute home life, and still watching over them while they are at school lest the lessons inculcated in the daytime are unlearnt at night. This may yield no immediate results of a visible kind in the factory, for the beneficiaries belong to the next generation; but the bread so cast upon the waters will assuredly be found after many days.

The Educational Value of Governmental Literature.

One result of a Royal Commission or Parliamentary Committee is a quantity of spade-work. Some say that there is not often any other, so perhaps the price of the visible results is in excess of its real market value. By spade-work we mean the delving and turning over of the mass of information, upon which the Commissioners or the committeemen have been fed, with the object of discovering something useful in the way of a general conclusion or a combination of statistics. (We are too polite to suggest that there is an apter metaphor than ours which might have been used.) Every worker attacks the ground from his point of view, and is concerned only to find certain things. Some look only for rocks to hurl at their neighbours, others are more charitably inclined, a few even being altruistic, desiring nothing but the good of mankind.

In any event, these Governmental inquiries bring grist to the mill of the journalist, who deserves all he gets if he does his work conscientiously, digging over all the minutes of evidence, of which the mere reading, without troubling about the meaning, is such a weariness to the spirit that not many attempt it once, and few cultivate it as a habit.

Undoubtedly there are few better practical text-books than these volumes of evidence, so long as the student is well enough grounded to appreciate the true value of every part, and that involves qualities which are not too common.

The London Traffic Commission and the Power Bills Committee are cases much to the point, for from them has emanated or will come an enormous quantity of information which cannot fail to interest and instruct large bodies of men.

If it were possible to edit the volumes, so that an immense amount of verbiage, of iteration, and of nonsense were omitted, and the salient facts, the really important statistics, and the maps and diagrams were arranged as they would be in a volume by a private individual, not only would there be a greater sale for the re-incarnated blue-books, but their educative value would be enhanced in an enormous degree; and, after all, it is the true function of any Government publication to inform not only members of Parliament but the whole of the people whom they represent.

We do not overlook the reports which are the sequels of these inquiries. In them the Commissioners give opinions and recommendations which are based on the evidence before them, and the invariably high standing and open-mindedness of the signatories render the reports as valuable for their immediate purposes as it is possible for them to be; but there are numbers of men to whom they serve merely as *hors d'œuvre* to a dinner, and our anxiety is to see that the meal shall be neither stodgy nor indigestible, neither repellent nor dangerous.

Perhaps a small but specialised editing committee might be attached to every commission if it were thought undesirable that the secretary should have such a responsibility thrown upon him alone, for the office of editor must include that of censor, or, shall we say, discriminator.

That which we wish might be done by private enterprise, but probably the best results would accrue to governmental publication.

A Point of Patent Law.

What are the rights of the licensee or purchaser of a patent? A licence is a permission granted by the patentee to some other person or persons to use or deal with the patented invention, or part of it, generally or in some particular manner, either throughout the whole or part of the territory covered by the patent, which without such permission would be contrary to the terms of the patent. In effect it is a limited exemption from liability in respect of infringement. The mere sale of a patented article, however, implies a licence to the purchaser to do certain things in respect of it. In a recent case Mr. Justice Buckley thus declared the law: If a patentee sells the patented article and the purchaser uses it, he does not infringe, because the law implies a licence by the patentee to the purchaser to sell or deal with the article as he pleases, unless at the time of the purchase the patentee imposed a condition. He also declared the rights of a purchaser from a licensee. If a purchaser buys from a licensee to whose licence the patentee has attached conditions, nothing turns (so far as licence is distinguished from estoppel is concerned) on the question whether the purchaser knew of the conditions or not. If a person innocently uses a patented invention, not knowing that there is a patent, he is none the less an infringer; and if he buys from a licensee, not knowing that there are limits to the licence, he is equally an

infringer. In this case, however, the patentee may be estopped from suing in certain circumstances, as, for instance, if he has acted in such a way as to lead the purchaser to suppose that the licence is not limited. In the case under notice the plaintiffs had granted a licence to sell a manufactured article to a certain society. The society sold to a firm who sold it to the defendant. The plaintiffs alleged that the implied licence in respect of the article in question contained a term which provided that the society, the licensee, should not sell to dealers, and that the defendant was a dealer. Both the plaintiffs and the society sold the goods with a label to the effect that they were not to be resold except in the original tins. Mr. Justice Buckley said that this label meant, by implication, that purchasers of the dye were licensed to resell it in the unopened original package, and that persons who were purchasers of the unopened original package were licensed to use the dye contained therein, and that such sales or uses were not infringements. From the course of business he held that the implied licence was subject to no other restrictions or conditions. He gave judgment for the defendant. This case illustrates the importance of a patentee who is granting a licence making the scope and extent of that licence absolutely clear.

Electrical Accidents, &c., in 1905.

The report of the Chief Inspector of Factories and Workshops is of interest from many points of view; we, however, can only deal with it from the electrical engineering standpoint, and elsewhere in this issue we give a *résumé* of the very able and broad-minded report of Mr. G. Scott Ram, H.M. Electrical Inspector, which is embodied in the Blue-book. From various other sections of the latter we cull a number of facts and statements which, though bearing on widely separated matters, are all related to electrical work.

Thus we learn that of 519 fires in factories in the County of London during 1905, only 9 were due to defective electrical circuits. The comparative immunity from accident in works supplied with energy by electric power companies receives favourable comment, while the increased risk of poisoning by carbon monoxide, which is present not only in blast furnace and producer gas, but nowadays also very often in illuminating gas, and the difficulty of making workmen realise its extremely dangerous properties, are noted. The total number of electrical accidents in 1905 was 186, of which six were fatal, an increase of 20 per cent., and 180 non-fatal, an increase of 35·3 per cent.

The use of mercury in the construction of electrolytic meters has introduced the risk of mercurial poisoning; 17 cases were reported in 1905, but none of a serious nature. By far the most serious risk of poisoning occurs, however, in connection with the manufacture of accumulators; and it is pleasing to record that in this respect a vast improvement has been effected during recent years. The present rules prescribed for the prevention of poisoning are appreciated by the employers and workmen; the former are more painstaking in enforcing them, and the latter more careful in their observance, though the dirty and careless habits of some of the employés continue to cause trouble. Nine new works were brought under the special regulations during 1905, making a total of 29 at the end of the year; 27 cases of plumbism were reported, but only one was fatal. Dr. Hugh Hughes, surgeon to a large factory in the north, has furnished an interesting report on the years 1897 to 1905, showing that the great majority of cases occur amongst mixers and pasters. The cases at this factory were reduced from 24 in 1901 to 1 in 1905. Some cases occur to men working away from the factory. A special patent soap, which precipitates the lead in the form of lead sulphide, has been found of value, and the men are provided with hot baths, milk and Epsom salts.

On the whole, there appears to be no reason to be dissatisfied with the state of the industry as indicated by these reports; electrical accidents form but a minute proportion of the 100,000 odd in all trades, and diseases due to electrical industries are almost non-existent.

THE BRITISH ASSOCIATION.

Chemical and Electrical Changes induced by Ultra-violet Light.

By Sir William Ramsay, K.C.B., and J. F. Spencer, M.Sc., Ph.D.

(Section A, Abstract.)

1. Light from an iron arc, falling on earth-connected plates of elements, placed at an angle of 45° to the cap of an electroscope discharges the electroscope. Even when an aluminium box earthed, the top closed with a gold or silver leaf so as to surround the plate of the electroscope completely, was interposed, discharge still occurred; but it became very slight when a thin aluminium leaf was substituted for the gold or silver. Discharge occurred when the electroscope was charged positively, but not negatively. The charge was approximately 800 volts.

2. As the iron arc proved unsteady, a Cooper-Hewitt uviol-glass mercury lamp was substituted. The illumination was insufficient to cause discharge through gold or silver leaf, but took place when the plate of the electroscope was exposed to the reflections. The rate of discharge caused by plates of 40 elements, metals and non-metals, was in the order of their position in the electric series, gold, iron, and manganese being notable exceptions. No discharge took place if the electroscope were negatively charged.

3. The rate of discharge was greatly increased, and this order was practically the same, when the plates formed part of the electroscope; in this case, however, it was necessary to charge the electroscope negatively, and again to 800 volts.

4. The sulphides of a number of the metals in the form of plates also caused discharge, but at a much slower rate; some iodides were also measured and found to cause discharge. The order, however, is quite distinct from that of the elements.

5. The plates gave a more rapid discharge with a fresh surface: they "tired," however, and the rate of falling off presented some peculiarities. For dyad metals the curve presents two obvious "breaks," and two places of constant rate of "tiring"; for tetrad metals, four such stages were observed.

6. A unifluid cell, containing two identical plates of copper cadmium, or gold, gives a small change of potential when one plate is illuminated by ultra-violet or sunlight in a tube of uviol-glass, the other plate being kept in the dark. That chemical action had occurred was obvious on examining the exposed plate.

All these phenomena are brought into line on the hypothesis that elements and compounds when illuminated discharge corpuscles.

Magnetic Survey of South Africa.

The Preliminary Report of the Committee appointed by Section A to continue the magnetic survey of South Africa commenced by Profs. Beattie and Morrison, shows that observations were taken at 22 stations in the Transkei, and at three stations in Bechuanaland. The observations at one of the Bechuanaland stations, viz., Mafeking, extended over four days, and the results furnished important information on the secular variation of the elements at this place. The other 24 stations were occupied for the first time.

The various astronomical and magnetic reductions have been carried out twice, and the results have been reduced to the epoch July 1st, 1903. Maps have been prepared showing the isomagnetics in the Transkei, and the magnetic anomalies for that region are being calculated.

Discussion on Mr. G. Gerald Stoney's Paper on "Recent Developments of the Steam Turbine," &c.

(Section G, Tuesday, August 7th.)

Dr. J. A. Ewing (chairman) said it was truly a remarkable record of the manner in which the steam turbine had now achieved success. Short of Mr. Parsons himself, there was no one who had a better title to tell them of that success than Mr. Stoney. The steam turbine was, as everybody knew, the fruit of the mechanical genius of the Hon. Charles Parsons—he used the word genius with a full sense of the care which should be exercised in the use of that word, for the quality was a rare one. Throughout his great work, almost from the beginning, if not from the very beginning of it, Mr. Parsons had had the assistance of Mr. Stoney as his right-hand man. It was just 15 years ago that he (Dr. Ewing) was invited by members of the Cambridge Corporation to make trials of what was then the newest form of prime mover—the steam turbine. A suggestion had been made that it should be adopted for the electric lighting of Cambridge, and the gentleman who consulted him was very strongly opposed to the introduction of such an untried novelty, so he was sent to make trials of a turbine at the works of Messrs. Parsons with the expectation that he would give a condemnation of what they thought was a foolish toy. He went with an open mind. Mr. Parsons put every possible facility for carrying out the tests at his disposal, including the services of Mr. Stoney, and he (the speaker) turned out to be a modern Balaam, for instead of cursing he came back altogether blessing the turbine. In 1897 Mr. Parsons invited him to go to Newcastle again in order to make some trials of his *Turbinia*. With his characteristic modesty Mr. Parsons did not say much about it beforehand, and he would never forget the sensation of surprise when he first of all turned on his full power and gave him a taste of the *Turbinia's* speed. It was a far cry from the *Turbinia* of those days to the turbines of

70,000 H.P. now being put into the great new Cunarders; there was no other form of steam engine that could be made of sufficient size. The steam turbine had undoubtedly arrived, and it was the engine of the future, the reciprocating engine being—for most purposes at least—doomed. Mr. Stoney and Mr. Parsons had still to show them how to make the turbine an internal combustion engine.

Mr. Robert Hammond also expressed enthusiastic admiration of Messrs. Parsons and Stoney's work. For years they had a difficult task, but they stood to it manfully, and had now achieved that great success. Their hopefulness was unbounded, for although it was by no means settled who should carry out the great power scheme for London, they had already made up their minds that the turbine was to be adopted, and that the order was going to them. That enthusiastic certainty had brought them a great deal of their success. He (Mr. Hammond) might have something to do with that supply, and in their last year's scheme they suggested the use of turbines of 10,000 KW. He was suggesting also the same size and type of plant in the Rand scheme. He thought that many of them had delayed the adoption of the turbine in their work from fear that possibly the blades would diminish in size—would be worn away by the action of the steam—and that gradually the turbine which started upon its career with the very high efficiencies named in Mr. Stoney's paper would become less and less efficient year by year. He thought it would be useful if Mr. Stoney could give them a few words on the retention by the turbine of its initial efficiency after some years' work.

Mr. Hawksley wanted to know whether Mr. Parsons could adapt the turbine to the use of motor-cars, and lessen their noise thereby. He understood that Mr. Parsons was considering the matter, but had not been able to see his way to do it, owing to the great reduction of speed required.

Mr. Maccall asked a few questions of the author which had application to some of the early turbines which were installed at Woolwich Arsenal. In regard to the effect of clearance on efficiency, when turbines were sent out first of all they had small clearance and good efficiency; but after they had been running a short time, owing to wear, the clearance was increased, or had to be, to prevent the danger of blades being bent. From the tests they had made at Woolwich, the efficiency fell off very considerably. The efficiency at low load fell off faster than with the reciprocating engine. That was a point of importance with a varying load, as in an electric lighting station.

Another speaker asked whether the turbine could be used for locomotives, mill engines, &c., where greater starting torque was required.

Mr. Stoney, in reply, said that the problem of the gas turbine was exceedingly difficult. They wanted a material that would stand bright white heat and a velocity of about 5,000 ft. a second. It was possible to make a gas turbine—he had made a model himself—but the consumption of gas was guaranteed to be not less than 10,000 cb. ft. per H.P.-hour. It was out of the range of practical politics, and at present he could hold out no hope. In regard to motor-cars, he thought the vibration and noise were due largely to their using petrol engines. Steam cars were very silent, but if they had a turbine they would have the same trouble with the boiler, besides that of the variation of speed and other things which he was afraid made the turbine almost as impossible for motor-cars as the gas turbine in the present state of knowledge. There was no cutting of the blades by the steam so long as the velocity was kept low. When they got to high velocities, as in the De Laval turbine, they got cutting of the blades by steam, but in the Parsons type there was none as a rule, and the economy did not go down. In certain cases they had sent out machines with too fine clearances, and as a consequence these had increased, but he had examined machines where the wear of the blades had been practically negligible. They had recently introduced very important modifications of the blades, so that small increases of clearance did not perceptibly decrease economy. The turbine could take very large overloads with very small reduction in economy. He was afraid that the application of the turbine, as it at present stood, to the locomotive and to mill work was very difficult. Heilmann proposed a locomotive with electric gearing, and it was possible that it might be tried again with the steam turbine, but the whole thing was not in the market yet. In reply to Col. Crompton, the author gave a few figures concerning the efficiency of turbine blowing engines.

Experiments Illustrating the Balancing of Engines.

By Prof. W. E. Dalby, M.A., B.Sc.

This was a lecture illustrated by experiments and lantern slides, and was delivered on Tuesday, August 7th, before Section G.

The movement of a piston was likened to the movement of a mass supported by a spring, and it was shown that its exact motion could be expressed in a Fourier series, the first and most important term of which corresponded exactly with the motion of the spring. The other terms corresponded to the spring when moving twice, three times, four times, &c., as fast, and supporting different weights.

Lantern slides were then shown, giving the actual values of the forces in the case of an engine of about 1,000 H.P.; it was pointed out that these forces could never be eliminated, and therefore they produced, or tended to produce, oscillation on the frame of the engine. These oscillations could be prevented by arranging other masses on the framework, so that the forces required to accelerate them formed, with the forces corresponding to the reciprocating masses, a system of forces in equilibrium. The larger problem, however, was so to arrange the actual working parts of the engine or machine that the reactions on the frame due to their several accelerations formed a system of forces in equilibrium amongst themselves. An experiment was shown to illustrate the action of these forces on the frame in the case of a model with a single line of parts. The model consisted of two cranks connected by a system of three equal spur wheels which enabled the cranks to be put at any angle with one another. When the cranks were together, an arrangement sometimes adopted in gas engine design, the vibration was extreme. When they were put at 180°, the vibration was nil at all speeds, notwithstanding the fact that the connecting rods were made as short as possible relatively to the cranks.

When the masses were in different planes they gave rise to centrifugal couples and introduced a second condition in balancing, this condition being that not only must the forces be in equilibrium amongst themselves, but the couples acting on the frame must also be in equilibrium amongst themselves. This was illustrated by a model which, supported on a pair of rollers, was first driven unbalanced and the oscillations exhibited. The reciprocating parts were then completely balanced by the addition of reciprocating masses, as in current locomotive practice, and at moderate speeds all trace of vibration disappeared. But as the speed increased the part of the balance weight used to balance the reciprocating masses, being unbalanced in the vertical plane, gave rise to a force sufficiently great to lift the model bodily off the rollers, showing, therefore, the necessity of the compromise which is usually adopted on English railways of balancing two-thirds only of the reciprocating parts.

It was then pointed out and illustrated by the use of a four-crank model that with the four-cylinder engine it was possible so to arrange the cranks and the masses of the pistons, that balancing in the horizontal direction could be carried out completely, without at the same time introducing any unbalanced forces vertically.

The question of balancing large marine engines was illustrated by means of a model hanging from springs. It was shown by a series of experiments how sensitive the balance was, especially to the variation of the angles between the cranks. The model was balanced so that it ran quite quietly upon the suspending springs. An alteration in the angle between the middle pair of cranks of 10° caused violent oscillation to be set up. The addition of a small mass to one of the lines of parts also caused the model to oscillate violently.

It was shown that at least five cranks were necessary to complete the balance of an engine of the ordinary type, so far as the first two terms of the Fourier series were concerned, and that a very good balance could be obtained with four cranks, but that with fewer than four cranks complete balance was impracticable with engines arranged in the ordinary way.

Discussion.

Col. Crompton said he had recently been called in as expert on behalf of St. Pancras Borough authority, which had been threatened with an injunction because of vibration said to be caused by its electrical machinery. That machinery, when first put down a few years ago, was an undoubted nuisance to the neighbourhood, and caused a whole line of houses to be vacated. Prof. Dalby was called in, and he succeeded in balancing the machinery in a marvellously effective manner. In spite of that, the inhabitants on the other side of the street were anxious to obtain a sum of money by the sale of their houses above value, and the result was that they attempted to blackmail the Borough Council by starting a second action. He (Col. Crompton) was called in to certify whether Prof. Dalby's efforts had been perfectly successful or the reverse. He had been in the former action on the other side, viz., that of those inconvenienced by the vibration. The first moment that he went into the lighting station he saw the enormous difference that had taken place. It was impossible to detect at any of the points where vibration had existed previously, any motion of any part of the building. He made observations at various distances radiating from the generating station, and he gradually increased the delicacy of his apparatus, until he was able to detect vibrations of such a character that he at first thought them to be set up by the engines which Prof. Dalby had treated. He had the means of stopping the whole machinery at certain times, and eventually he was able to find that the cause of the trouble was some deep-well pumps in the immediate neighbourhood. They triumphantly won the action with costs in their favour—a most rare thing in a case of that kind. It was the most triumphant case of successful balancing that he had known. When a matter of that kind had been so thoroughly thought out, they got results which warranted all the trouble and care expended on them.

Dr. J. A. Ewing, the chairman, in thanking Prof. Dalby, said: "I wish the L.C.C. had engaged Prof. Dalby's services before they put their big generating station down about half a mile from the Royal Observatory. That is a matter which I am just now investigating, and on that account it would not be proper to say more about it than to express one's sorrow that Prof. Dalby's services were not called in at an earlier period." (A voice: "Too late!")

Evening Lectures.

Prof. Silvanus P. Thompson, F.R.S., delivered the evening lecture to artisans, taking as his subject "The Manufacture of Light."

An evening lecture was delivered to the Association members by Dr. A. D. Waller on "The Electrical Signs of Life and their Abolition by Chloroform," many diagrams and lantern slides being displayed to illustrate his remarks.

Experiments for Improving the Construction of Practical Standards for Electrical Measurements.—Report of the Committee.

(Section A.)

In the last report reference was made to a conference of representatives of standardising laboratories which had been invited to meet in Berlin as a preliminary to the more formal Conference on Electric Units suggested at St. Louis.

The question of this preliminary Conference was brought before the Committee at a meeting on October 19th, 1905, and attention was called to the importance of Clause 2 of the provisional programme, viz.:—"Shall the three units, the ohm, ampere and volt, be defined independently, or shall only two be defined, and, if so, which?" And it was agreed unanimously that two units should be defined independently, and that these two should be the unit of resistance and the unit of current. The secretary was instructed to report this to the Conference at Berlin.

This Conference took place in October last at the Reichsanstalt in Charlottenburg, and was attended by representatives from America, Austria, Belgium, England, France and Germany.

Agenda prepared with great care by the President of the Reichsanstalt were very carefully discussed, and, as a result, the Conference expressed the wish that an International Convention should be summoned in order to arrive at agreement in the electric standards which are in use in the different countries.

The following resolution was further adopted:—"In view of the fact that the laws of the different countries in relation to electrical units are not in complete agreement, the Conference holds it desirable that an official conference should be summoned in the course of a year with the object of bringing about this agreement."

The Conference further expressed the opinion:—

1. That the information before it is not sufficient to enable it to propose any alteration in the formerly accepted value for the ampere.

2. That the information before it is not sufficient to enable it to law down exact directions in respect to the silver voltameter and the standard cell.

3. That if a proposal for a change in the accepted value of the ampere is to be brought from any source before a formal congress to be held later, an agreement in writing on the point should be come to previously between the parties interested. If differences of opinion in the matter cannot be removed, a new preliminary conference should be held.

The same procedure should be observed in regard to the specification for the silver voltameter and the standard cell, in the event of such specifications being submitted to a formal conference from any quarter.

The following formal decisions were agreed to:—

1. That only two electrical units shall be chosen as fundamental units.

2. The international ohm, defined by the resistance of a column of mercury, and the international ampere, defined by the deposition of silver, are to be taken as the fundamental electrical units.

3. The international volt is that electromotive force which produces an electric current of one international ampere in a conductor whose resistance is one international ohm.

4. The Weston cadmium cell shall be adopted as the standard cell.

Recommendations were also made as to realising the ohm, and some particulars as to the cadmium cell were agreed upon.

These results were laid before the Board of Trade, and a Departmental Committee, of which the secretary was a member, drew up a report recommending that an official conference should be invited to meet in London, and it is understood that negotiations are now on foot with view to summoning such a conference.

[This conference has already commenced work. See Elec. Rev., July 6th, p. 16.—Eds.]

During the year the work in connection with the absolute ampere balance has been in progress, and is practically complete. Under the supervision of Prof. Ayrton and Mr. Mather a large number of determinations have been made, and are most satisfactory. Detailed particulars are reserved until the work is complete; but there is little doubt that the balance is a most excellent absolute instrument, and that the probable error of a determination of current by means of it is only a few parts in 100,000.

The investigation of the silver voltameter has been extended beyond the limits originally thought to be necessary. The results so far obtained are very valuable, and appear to indicate that a satisfactory form of silver voltameter is realisable. It is hoped that the publication of the results will take place at the same time as those of the ampere balance.

An appendix by Mr. F. E. Smith describes the methods of comparing resistances in use at the National Physical Laboratory, and discusses the sources of error and the accuracy attainable.

The Electrical Discharge in Air and its Commercial Application.

By Sidney Leetham and William Cramp.

(Section B, Abstract.)

Since 1904 the authors have been engaged in developing an apparatus for the production of a peculiarly active gas for bleaching and sterilising purposes, discovered by Mr. Sidney Leetham in 1903, and now much used for flour-bleaching purposes. This work has led to a number of investigations on the electrical discharge, and of its effects on air, the results of which are given in the paper.

The Apparatus.—Consists essentially of an alternator, transformer, ozoniser and spark-box, the two latter being in series on the high tension side of the transformer. A current of air is caused to pass through these while they are excited, the general result being an extremely active modification of the air supplied.

The authors find that—

(*a*) All the types of electric discharge behave similarly, and need similar means for rendering them steady.

(*b*) With a properly arranged circuit, any desired type of discharge may be obtained, and, by proper regulation, may be gradually caused to pass to any other type.

(*c*) The number and distance apart of discharge points, shape of the points, the air velocity, and the frequency, all affect the discharge produced.

(*d*) So long as the air resistance is very high, the chief modification in the air is the production of ozone; but with the gradual breakdown of the air resistance, oxides of nitrogen are yielded, though this change does not appear to depend upon the temperature of the apparatus as might have been expected.

(*e*) The gas yielded is always in a state of ionisation, but the higher the air resistance, the less marked is this ionisation.

(*f*) Contrary to the statement of many authorities, ozone and oxides of nitrogen are found to exist side by side without mutual destruction.

(*g*) The bleaching action of the gas appears to be due to oxidation.

(*h*) Flour, treated by the gas, is found, for some unexplained reason, to absorb more water than similar flour untreated.

A Glass of Low Resistivity.

By Charles E. S. Phillips.

(Section A, Abstract.)

A glass which conducts electricity comparatively well may be obtained by fusing together sodium silicate and borax in the following proportions, viz.:—Sodium silicate, 32 parts; calcined borax, 8 parts.

If to this mixture 1·25 parts of Powell's flint glass be added, greater stability results, and the surface is improved without any serious loss of conductivity.

A glass suitable for the cases or windows of electrostatic instruments may thus be produced, capable of being cast into plates, but on account of its low fusion point, not otherwise very workable. It may, of course, be readily drawn into rods or fibres, and takes a fine polish. The density of the glass is 2·490, and it is somewhat harder than the ordinary soda glass of commerce.

With regard to other physical properties, it shows no fluorescence under cathode radiation, is very transparent to X-rays and opaque to ultra-violet light. Its electrical conductivity is about 500 times that of the most conducting glass so far made. The specific resistance of an average sample is of the order 10^9 ohms at 20° C., which, although high in itself, is exceedingly low for glass. When powdered and fused on to clean copper, it adheres well without cracking. The change of resistivity with heat (which is very marked) is being examined.

The Advent of Single-phase Electric Traction.

By C. F. Jenkin.

(Paper read before Section G on August 6th.)

It is often claimed by railway engineers that electricity cannot haul their trains as cheaply as steam, and that therefore steam is better, and will not be replaced. Let us allow that the assumption as to cost is true for the moment—is the deduction correct? It is generally true that engineering problems reduce themselves ultimately to questions of cost, and unless a process or undertaking will pay, it is no use to advocate its introduction. But there are many ways of paying besides the direct one, and it would probably be as easy to show a record of increasing costs in the history of the world's progress as to point to the record of reduced costs. To take two instances closely connected with our subject. Is railway carriage cheaper than canal carriage, which it replaced? Or, again, is incandescent electric lighting cheaper than gas? In such cases the public is willing to pay higher for the superior service, though it may not always be easy to define in what the superiority consists. It sometimes appears to be hardly more than a matter of fashion, but there are usually subsidiary advantages which account for the change, though these may not be easy to value in money. There are other cases where more expensive accommodation is provided to meet competition, though the public will pay no more for the better service; for example, the luxurious modern railway carriages.

Fortunately, electric traction is not one of these sources of expense which the railways are driven into adopting, though they do not increase their profits, nor will its adoption depend merely on fashion.

Why, then, is the new power so surely coming? Because it will increase the earning capacity of the line. This has been the experience with tramways from the beginning, and in more recent times with railways.

The following examples will illustrate the usual results of electrification. In 1901 the trams on the west side of London were electrified, and in three years, while the mileage was increased fourfold, the traffic increased 7½ fold.

The Manhattan line in New York was electrified the same year. In the first year after electrification the traffic increased 50 per

cent., and the costs of working fell from 55·79 per cent. to 41·2 per cent. of the gross receipts.

The Milan-Gallarate-Varese line was also electrified in 1901, and in three years the number of passengers carried increased 170 per cent.

On the North-Eastern Railway, at Newcastle, the traffic on the electric lines has increased 25 per cent., and the receipts have gone up from £129,000 to £151,000, while the costs have only risen from £42,761 to £47,779.

With these facts before us it is obvious that electricity cannot be condemned merely on the question of cost of power.

I have so far assumed that the cost of electric power is actually greater than that of steam power. This may sometimes be the case in England, where the electric power has to be generated by steam; but there are also many cases where the reverse will be true.

As an example of low costs of working, the figures published by Cserbati for the Valtellina line may be given. This line, which is 67 miles long, has been worked electrically since 1902. The costs for the first year after the line was taken over by the State were 0·0274d. per ton mile. This very low figure is accounted for by the fact that the power is generated by water, but if for the actual cost of power which is included in the above figure we substitute ½d. per unit—quite a possible figure for a large steam plant—the cost would only be 0·0336d. per ton mile. The actual cost of a similar line in the neighbourhood worked by steam was 0·067d. per ton mile, or just double the latter figure.

Numerous attempts have been made to arrive at a general comparison between the costs of electricity and steam, but these are all unsatisfactory and misleading, since the results depend almost entirely on the assumption made with regard to the nature of the service to be provided, the most economical conditions for steam being widely different from those for electricity. In almost all cases when electric working is introduced, the service is altered so that no simple basis remains for a comparison of cost. I do not, therefore, purpose to base any part of my argument on a possible direct saving in the cost of power. What then are the special merits of electricity, and how does electric working increase the earning capacity of the line?

The advantages of electrification may conveniently be classified under three heads, though there is no hard and fast line between them:—

1. Improvements affecting the comfort of the passengers.
2. Improvements relating to the train service.
3. Improvements relating to the working and capacity of the line.

Under the first two headings we may consider the advantages to the passengers, and under the third the advantages to the railway company.

1. The improvements affecting their comfort which passengers obtain from electrification are: purer air, less dirt, more light and warmth, and better lighting of suburban stations. It is not necessary to enlarge on the attraction of these.

2. The improvements in the train service which the passengers obtain are: faster trains and a more frequent service, and several others depending on modified methods of working the traffic, which will be referred to later. The attraction of fast trains need not be insisted on, and the importance of the frequency of the service is quite as great. In all the cases I have quoted the conversion to electric working has been accompanied by a great increase in the frequency of the service. On the North-Eastern Railway, for instance, the number of trains was doubled; on the Milan line the car-mileage was increased 2½ times the first year; on a line between Hartford and New Britain the traffic trebled in four months after electrification, the number of trains having increased four times. There can be no doubt that the success of electric trams is largely due to the frequency of the service, and the more nearly the railway service on suburban lines can approach this the more popular it will be. Thus electrification provides the public with a faster, more frequent, and more comfortable service of trains.

3. Turning now to the railway companies' point of view, let us consider how electrification affects the working and capacity of the line.

The higher speed and more frequent service which are possible on electric lines are due to the rapid acceleration which can be attained, and the saving in shunting at the termini possible with self-propelled trains. The decrease of time lost in stopping and starting at stations enables the trains to be spaced closer together; and this, combined with the higher average speed, may increase the carrying capacity of the line between 50 and 100 per cent. That electrification is the only way in which the carrying capacity of the suburban lines can be increased is pointed out in the report of the Royal Commission on London Traffic. On the Lancashire and Yorkshire line from Liverpool to Southport the number of trains was increased from 36 to 65 per day in each direction, concerning which the chairman stated that it "would have been absolutely impossible under the old conditions." The effect of this increased carrying capacity on the earning power of the line need hardly be pointed out. As the chairman of the North-Eastern Railway said:—"By running smaller trains, and more of them, they were able to serve the public better and make better profit themselves."

On main lines electrification will enable the railway companies to provide express trains running at much higher speeds than the present ones, and also to give a more frequent service, and to do more in the direction of through carriages. These advantages are due to the unlimited supply of power available at the train, and to the sub-division of the power along the train, which does away with the heavy concentrated load of the locomotive, a serious difficulty on light roads and weak bridges. The number of motors is proportional to the length of the train, and the speed is independent of the fireman's ability to keep steam and of the state of the weather.

The important trials at Zossen have shown what can be done in the direction of very high speeds. In England we are fortunate in already possessing lines sufficiently well built to enable trains of suitable design to run at much higher speeds than the present steam trains. Many of our main lines could carry trains running at an average speed of 80 miles an hour instead of something under 60 miles per hour; indeed, it is probable that higher speeds still could be used with perfect safety, and that the speed of our express trains could be increased 50 per cent. Such speeds would, of course, fall far short of those attained at Zossen, which reached 124 miles per hour; but they would be a very great increase on anything we have at present. Moreover, it would be easier to run a frequent service of small trains at this high speed than to run an occasional longer train; thus we should have the ideal condition from the travellers' point of view.

The advantages of the multiple-unit composition of the trains are many. In the first place, the saving of shunting at the termini is of immense importance; it affects both the size of the station and the cost and speed of working the trains. In the next place, it enables remarshalling of trains at junctions and the handling of through carriages to be very much simplified and quickened. Finally, it enables the size of the trains to be frequently varied, so as to correspond to the requirements, thus saving empty car-mileage. The working time-table of the North-Eastern Railway bears interesting testimony to the advantage which can be taken in practice of this power of altering the composition of the trains.

Subsidiary advantages of electrification depend on the supply of power all along the line. This may be usefully applied to working the signals, fog-signals, switches, turn-tables, pumps, capstans, lifts, &c. Electricity is already employed in this country for working signals to a considerable extent, and its use would certainly be much extended if a supply of current were available all along the line. The electrical operation of points is also already introduced into England; it has been widely used on the Continent for many years. Messrs. Siemens, Schuckert Werke have already installed complete gear for controlling over 3,000 points operated by motors. It would lead too far to go into the advantages of this system here, but there can be little doubt that it will be widely adopted wherever power is available at all the signal-boxes. With electric power available, it seems probable that improved methods of fog-signalling will be devised. The usefulness of electricity for working capstans, lifts, turn-tables, traversers, &c., is well known, and it is also probable that a good deal of the troublesome shunting in warehouses and sheds might be done by electric locomotives where steam locomotives are inadmissible owing to the danger of fire and the nuisance of smoke.

The absence of smoke will reduce the costs of the painting and cleaning of stations and ironwork in tunnels, &c. The troubles due to smoke in tunnels, particularly in the approaches to stations in towns, may alone be enough to make the introduction of electric working advisable; it was on this account, I believe, that electricity was first introduced into the great New York Central Station.

In addition to the advantages so far enumerated, electrification opens the way to new methods of working; and if the full benefits are to be reaped from the change of power, these new possibilities must not be neglected.

As I have already said, electrification is not simply a cheaper or more economical method of hauling trains. Electrical engineers do not say to the railway companies, "We can replace steam locomotives by electric locomotives and haul your trains at less cost." What we do say is, that if you electrify your lines they will pay better. The electrification will enable you to make your service much more popular; it will attract far more traffic, and it will enable you to carry that traffic which you could not do by the present means. The success of the tramways and the extraordinary growth of the habit of travel* in the populations where facilities of the right sort have been provided, show conclusively that there is an enormous traffic ready to be carried if it is properly catered for. Is not increase of traffic exactly what the English railway companies require at the present moment? I propose, therefore, to suggest a few of the ways in which present railway methods might be modified so as to meet the public needs. The alterations are only possible on electrified lines.

The first is a method of working the suburban traffic which has recently been successfully used in Germany. I refer to the running of the suburban railway trains over the tramways, thus bringing the trains to the public, instead of making the public go to the trains. The competition of tramways is being keenly felt by railway companies. Some are inclined to allow the local traffic to go, but this is a dangerous policy. Others, like the North-Eastern Railway in Newcastle, are meeting the competition successfully by electrifying their lines. In cases like this the extension of the railway service into the streets would probably be most useful. It is to meet the tramway competition that this method is being proposed in America. The extension of the Liverpool to Southport line as a tram in Southport would probably attract still

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* Number of journeys per head per annum.

Greater London.		Greater New York.	
1867	23	1860	47
1870	27	1870	118
1880	55	1880	182
1890	92	1890	283
1900	126	1900	320
1901	129		

more traffic; the somewhat similar extension at the other terminus on to the overhead line is already accomplished. Such a spreading out of the terminal station would also do something to reduce the crowding in the station and its approaches.

Electric traction opens the way for another important improvement. Every one who lives a moderate distance outside a large town wishes the railway company to run express trains to his station which shall not stop at any of the intermediate stations. As the passengers at every station hold the same views, the solution is impossible with ordinary steam trains, but it does not appear to be impossible with electric trains. Let us imagine the 5 p.m. train starting from London with a slip carriage for each local station along the line. It runs express to the furthest, dropping a car at each station as it passes. These cars, being motor-cars, are quickly run under their own power into the local siding. Instead of a separate slip carriage for every station, one for every two or three stations would be nearly as good; after being slipped at the first, it would proceed under its own power to the next station or two. The up train at 9 a.m. next morning is not so easily arranged, but several possibilities suggest themselves. First, there does not seem to be any real danger in allowing the individual cars from each station to run after the express train and to join it while running at considerable speed, though this plan may, perhaps, appear to be somewhat visionary. A simpler method is to let each car follow the last at the shortest block interval—say, 2 minutes. It can easily be shown that under ordinary conditions all the cars would arrive before the usual stopping train, and every one would have travelled at express speed. It is worth noting that such an arrangement would require only half the car-miles of the present arrangement, and about four-fifths of the energy; for though the speed is higher, each car only starts once instead of at every station. The defect of this arrangement is that the line near the terminus is blocked for some time by the stream of cars coming in one after the other, but this can be got over by bunching the cars into short trains. This will cause a few minutes' delay to some cars, but all will travel faster than the present stopping train. Such a train is for the suburban business-man, and does not provide for local traffic; but there can be no doubt that any line providing a few such express trains would at once attract a greatly increased number of residents to its districts.

My next suggestion relates to branch lines, which appear to be capable of doing far more than merely bringing a small quota of passengers to the junction to meet the main line trains. There seems to be no reason why branch lines should not develop a considerable local traffic. On the Continent small local lines and branches are made use of economically for a great number of purposes. In Holland, for instance, a local line has a train made up of two coaches, the first carrying first-class tourists and second-class peasants, the second carrying market produce, milk, &c., and a postal compartment. This line runs through a number of villages and into Amsterdam. It is largely used by the country people, and is very handy, as it runs through the main streets of each village, and picks up on the way. Certain trains in the day run in connection with boats and circular tourist routes, and carry large numbers of tourists in cars specially built for providing a good outlook, while other trains bring the market people into town and home again. Goods trains are also run on these lines for heavier merchandise. Much has been done in Belgium and Holland to assist agriculture by means of these primitive lines. There seems to be no reason why branch lines in England should not be extended as tramways through villages, thus picking up passengers and parcels; but for success a frequent service is essential. Similarly, the electric lines abroad furnish current for lighting all the villages *en route*, and every little group of cottages has electric light. Power is also supplied to local hotels and workshops, so that the carpenter has his circular-saw driven electrically, and so on.

These lines sometimes have primitive stations, and sometimes none; a simple platform and shelter, without ticket-office or station staff, is often sufficient. Such stations, under the name of "halts," are, I am glad to see, already being introduced into England. In some cases a simple staff system of block working is used, but where the lines approach more nearly to tramlines no signalling or block working is needed.

To make this class of line pay it must be built and worked economically. Everything which is not essential must be omitted; fences, stations, station staff, signals, must be reduced to a minimum, The lines must be allowed to creep and wriggle through village streets as best they can, without rigorous restrictions as to clearances at the corners. Let the cars go slow, and ring a bell, and scrape the corner house, as I saw them do in Holland. There are no restrictions on the careless farmer's cart at that corner; why should there be on the local trains which brings the careful farmer's wife and prosperity to the whole village?

It is the foolish cry for extravagant precautions which prevents the introduction into England of these methods, which have done so much for the welfare of the country districts abroad. The newspaper outcry over every death on a railway has caused the thoughtless public to demand more and more safeguards and protections to life and limb till our railways are the most expensive in the world. The result of this short-sighted cry for safety has been the checking of railway development and the high rates we have to pay for carriage. Have not the indirect effects of this policy, in depressing agriculture, in driving the country labourer into the crowded towns, and in want of work, been responsible for a thousand times the suffering; yes, and for hundreds of times as many deaths as the railways? Mr. Charles Booth (*Vide* Report of the Joint Select Committee on London Underground Railways, 1901) has given weighty evidence on the great importance of facilitating railway extension for the benefit of the population. But because the one man run over is seen and forms an attractive heading to a newspaper poster, we pay more attention to him than to the thousands who suffer inconspicuously.

Electric trams are responsible for numbers of fatal accidents, but, fortunately, the Press and public have not made the same outcry about them. The result is that the working populations of large towns are now rapidly spreading out into healthier districts in the suburbs, and it is hardly too much to say that hundreds of lives are saved by the healthier conditions of life for every one that is killed by accident. Sir Clifton Robinson has stated that the population in the district served by the London United Trams has increased in the five years since their introduction from 424,100 to 553,700—an increase of 109,600. It is a most fortunate fact that no Board of Trade returns are published about tram accidents. That useful department is keeping close watch over the trams; but the figures, which can be made such bad use of, are kept out of the hands of the scaremongers.

(*To be concluded.*)

ELECTRICAL ACCIDENTS IN 1905.

In the annual report of the Chief Inspector of Factories and Workshops, recently issued as a Government Blue-book, there is included the report of Mr. G. S. Ram, Electrical Inspector of Factories, which contains much statistical and other information of interest. Mr. Ram first discusses at some length the general question of electricity supply for power purposes, and shows that, by the use of modern plant of high efficiency and low cost, installed in favourable situations and working with a fairly high load factor, the power companies are enabled to supply electrical energy at prices undreamed of a few years ago; their competition has led to the reduction of prices in many districts supplied by older concerns, and many local authorities have taken advantage of the cheap supply in bulk, though not always in a sensible fashion—for instance, Mr. Ram cites a case where the sub-station is two miles from the centre of the load, and almost as far from the nearest customer! The bearing of this matter upon the subject of safety, with which the Inspector is chiefly concerned, lies in the restriction of capital outlay, which is of the first importance in its relation to the cost per unit, and leads to the cutting down of expenditure in connection with the transforming and delivery apparatus to a point sometimes involving personal danger.

Of the accidents in public supply works reported during 1905, 174 were of a non-electrical character, and seven of these were fatal; the largest proportion (51) was due to falls, while 22 occurred at engines and generators, 28 at steam-raising plant, 15 at coal-handling plant, and the remainder were due to falling bodies and miscellaneous accidents.

It is pleasing to note that the electrical accidents numbered only 35, and of these only three were fatal. The largest item (12) occurs in connection with switchboards, in ordinary routine work, mostly due, we regret to say, to faulty design; but none of these were fatal. Cleaning and repairing live switchboards added eight accidents, none fatal; four accidents occurred in adjusting brushes, one of which was fatal, and two fatal shocks were received by skilled men on switchboards *supposed* to have been rendered "dead." The non-fatal injuries were all burns, nine of them being caused by the arcing of switches. One man removed the protecting screen to examine a 6,000-volt transformer, and paid for his temerity with the fingers of his right hand. Fuses for instrument transformers should be put where they can be got at without danger from exposed conductors. A man who used a rubber mat, but no gloves, stepped off the mat upon an iron floor while working on high pressure apparatus, and was killed—thus showing the danger of metal flooring in front of a switchboard, and, indirectly, the value of rubber boots. Through a misunderstanding arising out of a telephone message, a sub-station switchboard was charged when a man was working on it, and he was killed; he was operating an isolating switch by hand, a practice condemned by the inspector. Neglect of the use of rubber gloves when adjusting the brushes of a rectifier led to the death of an experienced shift engineer. Two accidents took place within a few minutes at a works distribution board, due to attempts to replace a fuse on a horribly bad type of fitting; too often these boards are supplied by local contractors without due supervision on the part of the engineers responsible for the installation.

Turning to private electricity generating stations, the accidents reported were much fewer in number, and none were fatal. Non-electrical accidents numbered 35; electrical mishaps 18, of which half occurred on switchboards.

Electrical accidents reported in factories and works totalled 122, of which four were fatal. Arcing at switches and fuses caused 34 accidents; unprotected conductors accounted for eight, including two fatal; faulty apparatus, 22; working on live conductors, 24; flashing at motor brushes, four. Electric cranes caused 10 accidents (one fatal), and eight took place in testing electrical apparatus in course of manufacture—a very modest proportion, indicating the care taken to avoid them. The rest were miscellaneous. Mr. Ram characterises the fixing of a bare fuse directly over a switch as a "trap"; the operator turns on the switch on a faulty circuit, and "receives the full benefit of the explosion of molten metal and the heat of the arc on his hand or in his face, and the performance is called an *accident*!" "Bare metal fuses are best not used at all, but if used should be protected so that when they come into operation in ordinary working the fused metal cannot be scattered. They should also be single pole and be pro-

tected by switches, so that all pressure may be cut off when it is necessary to renew the fusible metal."

The Inspector is very severe on the use of unprotected conductors and fittings, for the sake of cheapness, and on the "erroneous belief that low pressures are safe under any conditions." A fatal shock was received from a three-phase motor switch at 220 volts, the probable pressure to earth received by the victim being not more than 130 volts. Another occurred on a 440-volt three-phase system, the pressure to earth being probably 250 volts.

Nine shocks or burns were received from portable lamps, which are apt to short-circuit at the lamps or where the flexible conductors enter the fitting, and six were due to short-circuits at the plug connectors of portable lamps, besides two similar accidents with portable drills; evidently there is much room for improvement in this direction. Owing to the flexibility of the wire and the length of slack, the victim of a shock cannot jerk himself free, and of course cannot open his hand, so that there is no escape for him.

Such an accident might occur even in domestic installations. A man was killed in this way on a 440-volt three-phase circuit, while another only escaped through the fortunate circumstance that he was on a platform 20 ft. from the ground at the time, and fell off it—thus breaking the connection. Such portable apparatus should be specially insulated, and so constructed that no metal part which might become accidentally charged, can possibly be touched. A flexible metal sheathing on the conductors, connected to the metal of the portable fitting, would be a good safeguard—*provided that it was properly and permanently earthed*; otherwise it might increase the danger.

The folly of working on live conductors is emphasised in the report, as in most cases the work could be done after factory hours in perfect safety.

A printing machine having stopped through the fuse blowing, the man in charge sent a message to the electrical attendant, and proceeded to do some work on the machine; unfortunately the switch had not been opened, and when the fuse was replaced the machine started at once and killed the man. Here carelessness was evident, but such an accident could not happen if a proper no-voltage cut-out were provided.

The Inspector makes some severe comments on the "traps," as he rightly calls them, to be found in some extra-high-pressure generating stations, where, for example, narrow passages are provided between rows of brick cells containing switchgear charged to 10,000 volts. Details of one exceptionally bad example are given. "Examples such as this merely show that even important stations are designed by persons having no regard whatever for the safety of those unfortunate beings who will subsequently have to work in them. The dangers described are wholly unnecessary, and it is such cases as this which may necessitate the introduction of strict regulations, which otherwise might be uncalled for."

"In another case I found a narrow passage with extra-high-pressure bus-bars all along one side, without any attempt at protection. In another I found a sub-station located in a blacksmith's shop on a consumer's premises. The only protection consisted of some flimsy chicken wire netting. Two feet from this netting was an anvil at which a man was working, and 3 ft. on the other side were bare 10,000-volt conductors. Want of thought in the arrangement of transforming sub-stations is often apparent; thus, I found one with the high pressure (2,500-volt) switch-gear just inside the door. There were unguarded high-pressure terminals, past which one had to squeeze through a narrow gangway to get to the farther end of the chamber. The floor at the high pressure end was damp from rain driving under the door. The conditions were, in fact, such as to invite a fatal 'accident.' This sub-station was the property of an authorised electric power company, but was on the consumer's premises. . . . . In one case, in an underground chamber of very limited dimensions, having, however, an entrance at the side, there was a high-pressure alternating-current switchboard at one end, having bare bus-bars on both the inner and outer conductors on the front of the marble panels. This board was, however, protected by a wooden rail in front, and a 'danger' notice was exhibited thereon. Within the rail there were also fixed, on either side of the switchboard, switch fuses, for controlling the high-pressure supply to the transformers, in such positions that it would be difficult to handle them without at the same time coming in contact with the high-pressure bus-bars. In the centre of the chamber were the exposed ends of some tramway feeders—550 volts continuous current—with bare couplings between the several cables. Near to these again, in the centre of the chamber and 3 ft. from the floor, were the bare ends and cross-connections of some triple-concentric 460-volt feeders. These were evidently regarded with some mistrust, as they were 'protected' by some newspaper tied on with string! . . . Other examples occurred in this town of sub-stations arranged to offer the maximum of inconvenience as well as no little danger to persons employed. In some places where work of this order is found the engineer who originally 'designed' them has left the scene, and his successor has been deeply grateful to me for condemning them, and thereby enabling him to obtain the necessary funds for putting them in order, which he had previously experienced difficulty in obtaining. In another large sub-station which I visited there had previously been trouble at the extra-high-pressure switchboard, with the result that the attendants had no confidence in it. While I was there a telephone message was received from the generating station to the effect that another feeder was about to be switched on. The switchboard attendant promptly got behind an iron column, and the engineer and the consulting engineer, who were present, hid behind a motor-generator, and, following their example, I did the same, just as if we were in a slate quarry when a shot was about to be fired. Such an undignified exhibition, founded on previous experience, afforded an instructive object-lesson on the merits of that type of switchboard. Previous experience had shown that persons were not safe, even at a considerable distance away, from an occasional bombardment by pottery ware and flaming oil from the fuses."

The Inspector refers to the draft regulations issued by the Home Secretary in 1904, dealing with the use of electricity at medium pressure in factories; these met with a certain amount of opposition, and the matter is now under consideration with a view to the issue of a more complete code. This will include within its scope installations of all sizes, not omitting generating stations. "Many stations are well arranged and protected, the chief engineers not allowing any operations to be performed, or any apparatus to be used by their employés which they would not unhesitatingly undertake or use themselves. Were this practice universal, regulations would be unnecessary, but . . . . experience shows that this important matter of safety is often entirely overlooked." Mr. Ram has drawn up suggestions for such a code of regulations, endeavouring to meet the requirements without proposing unnecessary conditions which might be held to involve useless expense, or to impose unnecessary restrictions which might hinder progress.

The report includes a number of tabular statements relating to accidents, and concludes with a table of electrical fatalities during 1905.

PARLIAMENTARY.

Royal Assent.—The Royal Assent has been declared to the following:—

Electric Lighting Orders Confirmation (No. 3) Act, 1906.
Electric Lighting Orders Confirmation (No. 4) Act, 1906.
Electric Lighting Orders Confirmation (No. 7) Act, 1906.
Tramways Orders Confirmation Act, 1906.
Ascot District Gas and Electricity Act, 1906.
Derbyshire and Nottinghamshire Electric Power Act, 1906.
West Yorkshire Tramways Act, 1906.
London County Council (General Powers) Act, 1906.
London United Tramways Act, 1906.
Twickenham and Teddington Electric Supply Co.'s Act, 1906.
Wirral Railway Act, 1906.
Newcastle-upon-Tyne Electric Supply Co.'s Act, 1906.
Baker Street and Waterloo Railway Act, 1906.
Southport and Lytham Tramroad Act, 1906.
Wallasey Tramways and Improvements Act, 1906.
Kent Electric Power Act, 1906.
Folkestone, Sandgate and Hythe Tramways Act, 1906.
Cork City Railways Act, 1906.
Macclesfield and District Tramways Act, 1906.
Corporation of London (Blackfriars and other Bridges) Act, 1906.
London County Council (Tramways and Improvements) Act, 1906.
County of Durham Electric Power Supply Act, 1906.
Shropshire, Worcestershire and Staffordshire Electric Power Act, 1906.
Hackney Electricity Act, 1906.
North-West London Railway Act, 1906.
St. Pancras Electricity Act, 1906.
South Wales Electrical Power Distribution Co. Act, 1906.
Watford and Edgware Railway Act, 1906.
Lancashire Electric Power Act, 1906.

LEGAL.

Dudley, Stourbridge and District Electric Traction Co., Ltd., *v.* Corporation of Dudley.

This case came before the Court of Appeal again on Thursday last week. The question in dispute was as to the basis on which valuation was to be made of a light railway, which was being taken over by the Corporation from the company—whether the Light Railways Act or the Tramways Act should apply.

The case had stood over in order that the sanction of the Board of Trade might be obtained to the appointment of an arbitrator. Sanction having been given, Mr. Cripps, K.C. (with him Mr. R. J. Parker) addressed the Court on behalf of the plaintiffs, the appellants contending that the decision of Mr. Justice Swinfen Eady was wrong.

Lord Justice Swinfen Eady, however, interrupting the argument, said the Court was not satisfied with the case that had so far been presented to them, and suggested that the arbitrator should be asked to state in his own language what led him to adopt the particular figure which had been presented to the Court.

The appeal was accordingly directed to stand over to enable this to be done.

Mogridge *v.* J. G. White & Co., Ltd.

While defendants were engaged laying tramways in York Road, Wandsworth, plaintiff, a workman, who was walking along the road, caught his foot in an iron plate which had been left on the footpath. He claimed £60 for personal injuries sustained, but at the City of London Court a jury awarded him £25 and costs.

REVIEWS.

Whittaker's Electrical Engineer's Pocket-Book. Edited by Kenelm Edgcumbe, M.I.E.E. Second edition, 1906. London: Whittaker & Co. 3s. 6d. net.

The editor states in his preface that "No pains have, moreover, been spared to ensure that accuracy which is so essential to the usefulness of a pocket-book of this description." Unfortunately, we cannot congratulate him on the result of his labours. We think that anyone who has had experience in proof reading could find out misprints—dozens of them—in an hour or so. There are in addition many serious errors. Possibly our lengthened experience in consulting all manner of pocket-books has made us unduly critical. We have never come across a book of this type without being offending by glaring inconsistencies and misleading statements. We do not hope, of course, to find a book as rigorously accurate, or as entirely free from misprints, as Todhunter's Euclid, but we had hoped to find an English "Hospitalier's Formulaire," where the misprints are few, and the few errors (there are still some left after 20 editions) are difficult to detect.

On p. 13 some extremely quaint mathematical theorems are given, such as— $a^m + a^n = a^{m+n}$; $a^{-n} = \frac{1}{a^n}$; $\log \frac{m}{n} = \log - m \log n$.

We would suggest that the formula given for the centre of gravity of the sector of a circle on p. 31 is not correct. On p. 32 we are told that the centre of gravity of a prism is the intersection of its diagonals. We wonder what the diagonals of a prism are. On p. 33 a simple formula is given for the periphery of an ellipse, correct apparently to five significant figures. What a pity Jacobi and Legendre wasted their lives calculating out the elliptic functions. On the same page also the periphery of a parabola is expressed in units of area.

On p. 70, under the heading "Fly-wheels," appears the truly astounding formula—

$$\text{Weight of fly-wheel} = 43{,}257 \text{ P } kr/(\text{R}^2 n^3).$$

We always thought that the specific gravity of this kind of iron could only be foretold roughly to within 3 or 4 per cent. The constant, however, is given to five figures.

On p. 96 it is stated that when the magnetising force is small the permeability is small. Lord Rayleigh proved, however, that for many kinds of iron and steel the permeability is constant for small forces, and in many cases it is as large as 100. On p. 102 we are told that the inductance of a coil is proportional to the square of the number of turns *other things being equal*. We fail to grasp how other things can be equal—in fact, it is a physical impossibility. On p. 107 it is said that "if an E.M.F. of V volts be applied to a circuit of inductance L henries, the rate of change of current will be equal to V/L amperes per second." We wonder how long the current continues growing at this rate. The explanation of the "skin effect" given is very feeble. "Sloppy" explanations of this kind bring mathematics into disrepute with practical people.

P. 127 is the worst page in the book, as nearly all the formulæ given on it are hopelessly wrong. We pity anyone who has attempted to use them. For instance, formulæ are given for the capacity and inductance of two equal spheres. The slightest consideration will show that the inductance of the spheres must depend on how the currents are flowing in them. The capacity is given as the radius of either. Whatever is meant by "capacity," this is quite wrong. It would be interesting to know from what source these formulæ were derived. The correct formulæ have been known for years; unfortunately, they are not simple, and consequently are not favoured by those who like to simplify mathematics.

We have come across many other mistakes and misprints, some of which are gross and palpable, like "poles per minute," "Gleichstrommuseline," "Chaturn" for "Chatwood," "Fisher-Hinnen" for "Fischer-Hinnen," &c. We hope to see radical alterations made in the next edition.

Le Centrali Elettriche degli Stati Uniti d'America. By Elvio Soleri. Rome: *L'Elettricista*. 1906. Price L. 4.

The author, who is the chief engineer of one of the larges constructional works in Italy, was directed by the Italian Minister of Industry and Commerce to visit the important electrical stations in the United States of America, and the work under review is a summary of his reports. A few pages are dedicated to the association of Edison with the early work done in America; this is succeeded by interesting tables of statistics, which, however, only date to 1902; had these figures been to the end of 1904 or 1905, their value would have been very much greater. They deal with many items which are not usually published in connection with British undertakings; wages are classified under the different heads for both inside and outside workmen, showing the number of men earning from 75 cents a day (the intermediate steps being 25 cents) to $5 a day and upwards in the respective departments. It is impossible in some places to follow whether the author is using figures which indicate American or Italian units. The work would be improved by keeping one system of units throughout the book, or clearly indicating for each table what is intended. In the classification of distributing systems the figures total 125,000 miles of conductors, 6·5 per cent. only of which are underground, the rest being overhead.

The author finds great similarity in the general type of central stations where steam is used, throughout the States—water-tube boilers, vertical engines with Corliss valves, and direct-coupled generators—whilst the steam turbine is rapidly forcing its way into the larger stations. The reports give an indication that working at 25,000 volts has now become such a matter of every-day practice that no great difficulty remains to be overcome in transmitting at this pressure, which the author finds is generally adopted for distances up to about 30 miles. The generation is, however, usually effected at a maximum pressure of 6,600 volts, which has become a recognised standard.

The author expresses considerable surprise at the scarcity of systems of low-tension distribution by alternating currents in the States. Almost everywhere he finds that rotary converters are employed, and direct currents provided from local centres; this he attributes largely to the commercial instincts at work on the profitable development of the direct-current motor, and the suppression of the Ferraris and Tesla alternating current motor patents. Figures given show that at New York there are about 15,000 motors on the network with a total capacity of 85,000 H.P., and at Chicago 9,000 motors of 43,230 H.P.; as, however, many of these are from 1½ to 2 H.P., it is pointed out that the starting current in the morning required for a large number of alternating current motors would necessarily upset any distributing arrangements.

Excellent descriptions are given of the New York Edison Co.'s Waterside station, and the undertakings of the same company at Brooklyn and Chicago; followed by the generating works and supply to the elevated railways in New York, Brooklyn and Boston: the Niagara works; and on the Pacific, the Bay Counties power system, and that of the Seattle Co. The work, as a whole, is simply descriptive, unaccompanied with such pros and cons as must have occurred to the author in making his notes; perhaps he is reserving these for a future edition.

Mechanical Stoking.—The application of mechanical stokers to the purpose of generating steam in the South Wales coalfields has hitherto been very restricted when compared with the English coalfields. This limited application is in great part due to the difficulties experienced in adapting any particular type of furnace to deal efficiently with the great variety of coals worked in this district, varying from the highly bituminous coals of the west valleys of Monmouthshire and the Forest of Dean to the dry anthracites above Swansea. Messrs. E. Bennis & Co., of Little Hulton, Bolton, have during the past three years been making a special study of the coals of this field, and have adapted their patent compressed-air furnace and self-cleaning machine stokers to burn coals as far apart as Llanelly and Rhymney, adjusting furnace temperatures, air pressure and the self-cleaning arrangements of the furnaces to suit individual qualities of fuel. Messrs. Bennis & Co. have successfully put to work large installations of furnaces and conveying plant at the pits of the Glamorgan Coal Co., Ocean Coal Co., Powell Duffryn Coal Co., Albion Coal Co., and Cardiff Coal Co.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Hawkes v. The Electrical Corporation, Ltd., and Joseph Augustus Bauer.

Our client, Mr. O. C. Hawkes, has called our attention to the letter of Messrs. Parker and Richardson, dated July 31st, 1906, appearing in your issue of August 3rd. As this letter may possibly cause an erroneous impression, we take this opportunity of briefly stating the facts in connection with the trial and the decision in the action. The action was brought by our client to obtain rescission of a contract to take shares, 6,500 of £1 each, in the corporation in respect of which shares he had already paid the sum of £4,000, and upon which a further call of £2,500 had been made. In the action our client further claimed the repayment of the £4,000 already paid by him in respect of such shares and rectification of the register of the corporation by removing his name therefrom. The grounds on which our client claimed rescission of the contract to take these shares, rectification of the register and repayment of the sum of £4,000 already paid by him, were that he had been induced to take such shares and part with his money by the false and fraudulent misrepresentation of the defendant, Joseph Augustus Bauer, who was a director of the corporation at the time when our client was induced to become a shareholder, and was acting as its agent. After the case had been going on for a day and a half, and before even our client's case had been fully gone into, the corporation, which was represented by the same solicitors and counsel as Mr. Bauer, consented to judgment in favour of our client against the corporation. By such judgment our client obtained rescission of the contract to take shares, and the corporation was ordered to repay to him the sum of £4,000, which he had already paid for the shares, together with the costs of the action.

As against Mr. Bauer, our client claimed damages, which was the only claim in law open to him to make. As the corporation was willing to consent to the judgment already mentioned, and as our client thus obtained the main object for which the action was brought, he consented, in order to save further expense to himself, to the settlement of the action upon the terms of getting judgment against the corporation, and abandoning his claim for damages against Mr. Bauer upon the terms that he was neither to pay Mr. Bauer any costs nor receive any costs from Mr. Bauer. At the request of Mr. Bauer's counsel, he consented to this compromise being effected by allowing judgment to be entered for Mr. Bauer, but without costs. We wish, further, on behalf of our client, to point out that, if the corporation had succeeded in establishing its defence, it would have been entitled to get from our client £2,500 as calls on his shares, and in that case the corporation would not have been insolvent. On the contrary, it would have had a substantial amount to its credit on a winding-up. Mr. Bauer, who was also promoter, chairman and managing director of the corporation, would, as a holder of over 6,000 shares, have taken a considerable portion of such balance after the corporation had discharged its indebtedness.

We would ask you to insert this letter in order that your readers may be able to judge of the accuracy of your report.

Hare & Co.

London, E.C., *August 8th*, 1906.

Electricity in Collieries.

In reference to the correspondence in your issue of the 10th inst., I think I am correct in saying that the electric pumping plant at Trafalgar Colliery, Forest of Dean, was installed in 1882. The pump and motor are still at work, but the generator, an old Siemens type, although still to be seen at the colliery, is not working. In 1886 a much larger pump was put to work.

The original motor was about 5 H.P. I think this can fairly claim to be the first application of electric power in collieries.

W. A. Scott.

Cardiff, *August 11th*, 1906.

Manufacturers Selling Direct to Consumers.

With reference to "Cable's" letter on above subject, this "hardy annual" has cropped up again. The remedy is in the hands of the contractors, *i.e.*, buy from manufacturers who do not go direct to consumers; there are still a few of these left.

The Contractors' Associations can give contractors particulars of these firms; there are also still a few of these left.

R. B.

If the suggestion of "One of the Pinched" be followed, viz., to start a black list of manufacturers and wholesale houses trading direct, then I think there will hardly be a firm of note in the wholesale electrical trade who will not adorn this list.

Let us take a broad-minded view of the circumstances. Suppose A be a wholesale draper in Bradford, and he requires some arc lamps and motors installing; he has already his private plant and a man on the premises to look after same, who can do his own wiring.

A asks one contractor in his town for an estimate, and also a wholesale firm. The wholesale firm gets the order; now, if the contractor had secured the order, he would have bought the arc lamp and motors from some other wholesale house (probably an agent for some German makers). What logical reason is there that the wholesale house should make the contractor a present of a commission? Again, take the case of a private firm requiring lamps, why should any wholesale house refuse the order if they know that the local contractor does not do business with them? Another instance: a colliery requiring some large cables asks two contractors and a wholesale house or cable maker to quote. The probabilities are that the contractor will go through a list of agents of foreign cable makers, get their prices and quote; the English cable maker, if he does not wish to lose the order, will quote a reasonable price direct and may possibly get the business. With every respect to "One of the Pinched," I do not think that a black list will seriously dismay any important wholesale firm, for the reason that the contractor who is wise in his generation will purchase where he finds it to his advantage.

Competition is terribly keen in the electrical trade; every other non-successful contractor poses as a wholesale house, and if he cannot get business one way he tries another; and after all, can he be blamed?

I strongly disagree with a wholesale house doing business with their own clients' customers, to the disadvantage of the client, but no wholesale firms who knew their business would do this.

The Northern Electrical Co. have, in my opinion, no cause for complaint in the particular instance they cite; they admit that the firm who call on the large drapery establishment do not call on them, neither do they do any business with them. Surely the Electrical Company should not be barred from Doncaster because of this.

I have been connected with a wholesale manufacturing house for many years, and I attribute the inclination to direct trading to the following: Stress of competition, lack of support by contractors to the English manufacturing houses, unstable financial position of contractors generally.

There are a number of contractors to whom my remarks do not apply, who support with all their power the manufacturer, who, in his turn, is pleased to support the contractor. Such contractors are usually the successful ones, and display by their originality and pushfulness that the electrical trade can be a prosperous one for the contractor who works, but not for the contractor who expects the wholesale house to provide the profits.

Transgressor.

Rapid Methods of Electro-Typing.

I have read "Nemo's" letter in your issue of August 3rd, and shall be pleased to reply to his criticisms if he will publish his name.

Sherard Cowper-Coles.

London, S.W., *August 7th*, 1906.

The Penetrating Properties of the Arc Light.

I was much interested in Mr. Bastian's letter, which appeared under the above heading in your issue of the 3rd inst., and especially in his concluding query as to why "distant objects appear blue," on which point he solicits explanation.

Might I be permitted to point out to him that, to me, and, I believe, to a good many others, the sun, on setting behind a mist-laden evening atmosphere, usually appears distinctly red. I do not know whether Mr. Bastian is in any way interested in Art, but I have no doubt that we may one day expect to see his name figure prominently in the Academy list, as I am sure a "sea-scape" with a cobalt rising moon would be the sensation of the season.

The cause of the reddish appearance of the setting sun is that, of all its mixed rays, only the red are capable of penetrating through the thick layer of misty atmosphere, the blue rays being absorbed and diffused, thereby causing the bluish appearance of the sky. For the same reason a thick layer of air seen against a distant dark hill, and through which the sun is shining, will generally appear as a bluish haze, the yellow rays being transmitted through with less absorption and illuminating the ground below.

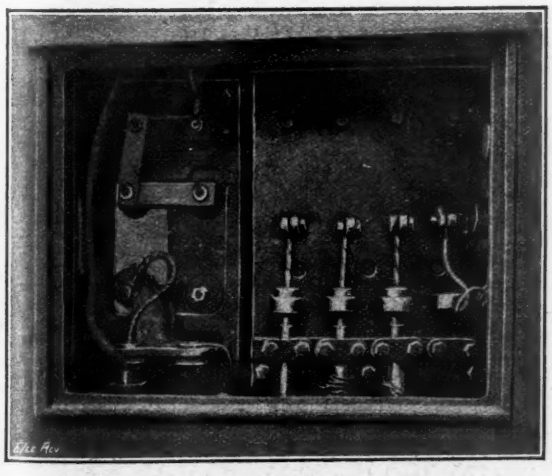
Might I recommend Mr. Bastian to compare different illuminants through a vessel containing milky water, or better still, water with a slight silver chloride precipitate?

G. Marinier.

Manchester, *August 3rd*, 1906.

Sad Fate of a Venturesome Rat.

I am sending herewith a photograph which shows the back panel of one of our road box transformers. The high pressure side is on the left, and is divided off by a fibre partition from the L.P. connections, the front being covered by a removable fibre door. The district supplied by this transformer was in the dark a night or two ago, and on investigation we found that a rat had climbed up the ironwork, seated itself upon the iron flange to which the H.P. terminal end is fixed, and had stepped up therefrom with its front paws on the high pressure terminal stud, the result being



RAT IN TRANSFORMER CASE.

that the rat was electrocuted. This immediately set up an earth which brought down the high pressure fuse on this section. The rat was very badly burnt on the chest and fore paws. This being an interesting and instructive case, I had the photograph referred to taken, which should be an object lesson to mains superintendents, and shows the wisdom of securely covering, by means of a metal grate, the drain pipe. In this instance the cast-iron cover had been accidentally omitted, and the rat evidently had got into the transformer from the drain.

Geo. Wilkinson.

Harrogate, *August 18th*, 1906.

Wireless Telegraphy.

My attention has been drawn to the letter of Prof. Fessenden in your issue of August 10th. As I am at present away from London, and parted from all books and papers, I cannot at the moment supply the reference for which Prof. Fessenden asks, as to the first date of publication of any description of my alternating current galvanometer, in which a metallic ring or disk is suspended in the interior of a coil and deflected when an alternating current passes through the coil. Having mentioned this fact 20 years ago to Dr. Shelford Bidwell, a galvanometer on my principle was shown by him to the Physical Society, and mentioned briefly in reports in the current technical journals, but I cannot supply the date until I return to London.

Shortly afterwards I exhibited a similar alternating current galvanometer at a Royal Society soirée. I was not at that time aware that Prof. Elihu Thomson had independently discovered the facts of the repulsive action of an alternating current upon metallic disks or rings.

Provisionally, I may say that I think it was in 1886 that my copper disk galvanometer was shown to the Physical Society and described in the electrical papers; but as my memory may be at fault, I must reserve a definite statement until my return to London.

J. A. Fleming.

Harrogate, *August 10th*, 1906.

Inaccurate Electricity Meters.

I have read "P. T. O.'s" letter, in which he relates his experience with regard to the condition of new meters fresh from the manufacturers.

My experience leads me to differ from him when he states that the testing of new meters is of little value, for it is well known that the rough methods used in modern carting are hardly those which contribute to any good results from the meters. Your correspondent has been fortunate in not finding errors exceeding 2½ per cent., although much depends upon the type of meter. However, I cannot claim to have attained such good results.

Does "P. T. O." make any distinction between a faulty meter (anything above, say, 2½ per cent. error) and a meter damaged in transit? If so, it would be interesting to know where he draws the line, and by what means he is able to make the distinction, for the damage in transit may be of such a nature as to be quite unnoticeable, until the meter is subjected to a test, or, rather, a series of tests.

P. O. Wittey.

Walthamstow, *August 11th*, 1906.

ADDRESS WANTED.—Mr. G. Vaughan is requested to forward his address.

COAL TESTING.

BY ROLAND C. WILD, F.I.C.

THE importance of testing coal is not sufficiently recognised by central station engineers and others who have to buy and deal with large quantities of coal for boiler purposes, and they very often do not fully realise that what they want to buy is not tons of coal but potential heat units—of course, in a form suitable for the particular type of furnace in which it is to be used.

It is not economical to pay the same price for ash and water as for the combustible part of the coal; and besides, a high ash content not only lessens the amount of combustible matter actually present, but also by enclosing part of it makes some of it not available, this occurring especially when the ash is the more easily fritted. The ash content may vary from about 1 per cent. to 30 per cent., the calorific value of the coal with the 1 per cent. of ash being probably 15,000 B.TH.U., or slightly more, and that of the coal with the 30 per cent. of ash being not above 10,500

B.TH.U.; but the first would be completely burnt, while the second would not give its full calorific value, as the ash would contain a considerable quantity of unburnt combustible matter. The moisture, besides lessening the proportion of combustible matter, requires heat to vaporise it, amounting to 10 B.TH.U. for each 1 per cent. of moisture contained in the coal, not a very large matter, it is true, but not quite negligible.

The usual tests required are the determination of moisture, ash and calorific value, and sometimes it is desirable to determine as well the volatile matter and the fixed carbon which, with the ash, makes up the coke. These are a useful guide to the smokelessness of the coal and its coking properties.

The determination of moisture is made by heating a quantity of from 10 to 20 grammes of the coal on a watch glass in an air oven, at a temperature of 220° F. The ash determination is generally performed by weighing 1 gramme of the coal into a platinum boat, which is placed in a combustion tube and heated at first gently and then to redness, while a current of air or oxygen passes over the coal; the coal is burnt completely and the weight of the ash taken.

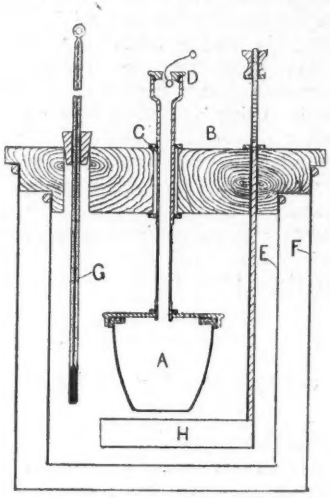
The calorific value may be determined in two ways, either by calculation from the elementary analysis of the coal or by a calorimeter experiment. The calculation is either made from Dulong's original formula, $14544C + 61524 (H - O/8)$, or from various modifications of it which have been proposed from time to time. The calculation does not, however, give very good results, and may, in fact, be as much as 10 per cent. from the correct value, and besides this the elementary analysis takes a considerable amount of time and skill to perform; but if the analysis of the coal be already known the calculation method may be used to obtain a rough approximation to the calorific value.

The calorimeter experiment consists in burning a small quantity of the coal and absorbing the heat produced in a known quantity of water, and finding the increase in temperature of the water due to the combustion. There are practically four types of apparatus designed for this purpose.

The Lewis Thompson apparatus, which has been very generally used, consists of a combustion chamber containing the coal mixed with a mixture of nitre and potassium chlorate, and a glass jar containing a measured quantity of water. The coal is ignited by a fuse, the combustion chamber containing the coal is put in the water, and the products of combustion bubble through the water, which rises in temperature. No attempt is made to prevent radiation or to break up the bubbles of gas, which consequently do not give up all their heat to the water, so it is usual to add 10 per cent. to the result found to make up for these and other losses; 15 per cent. is sometimes recommended, and this is probably better, as the results are generally low, often as much as 8 per cent. Sometimes it is not easy to find the correct proportions of coal and oxygen mixture, and the combustion will not start, or if it starts it will stop before the coal is burnt; the combustion is seldom complete, a little coal being nearly always left unburnt, and with anthracite or coke the combustion is so difficult that it is practically impossible to use the apparatus for these.

The oxygen type of calorimeter, such as the William Thompson, Darling and others, generally consists of a bell inside a vessel of water; under the bell is a platinum or porcelain crucible in which the coal is placed, or in some cases the coal is moulded into a pastille and placed in a wire basket. Oxygen enters at the top of the bell, and with the products of combustion bubbles through the water; the combustion is started electrically and goes on until the coal is burnt. Some forms of apparatus have outer vessels to prevent radiation, and various arrangements of wire gauze to break up the bubbles of gas as they pass through the water. The results are generally fairly concordant among themselves if a well-designed form of apparatus be used, but they have a tendency to be low, as it is very difficult to burn the coal, especially if it is bituminous, without getting a little smoke at the start, and sometimes the combustion is not complete owing to a covering of ash preventing the oxygen from reaching the unburnt coal.

The bomb type of calorimeter consists essentially of a closed iron vessel lined with platinum and able to bear a high pressure. The coal is placed in this vessel on a small dish and the vessel closed; it is then filled with compressed oxygen, suspended in a water vessel containing a known volume of water, the coal fired electrically and the rise of temperature taken. The bomb gives very good results, but it is a very expensive and complicated apparatus, and requires skilled handling to obtain trustworthy results. As the bomb has to bear the high pressure due to an explosion, it must necessarily be thick and heavy; consequently it has a high water equivalent, as much as 300 or 400 grammes, and as a rule the rise of temperature is only about 4° F. Under these circumstances it will be seen that very great precautions must be taken to avoid errors, as small differences in the rise of temperature make a large difference in the result obtained.



A, Combustion chamber; B, Wooden cover; C, Tube suspending combustion chamber; D, Valve; E, Water vessel; F, Insulating vessel; G, Thermometer; H, Stirrer.

DIAGRAM OF THE SODIUM PEROXIDE CALORIMETER USED BY THE WRITER.

The sodium peroxide calorimeter, such as the Parr or that designed by the writer, which he has been using for the last two years in the work of the Westminster Electrical Testing Laboratory with satisfactory results, has some of the advantages of both the bomb and the oxygen type. As with the bomb, the gas does not escape or bubble through the water, but is absorbed by the sodium peroxide, and like the oxygen type, it can be made cheaply and simply. As they have very little pressure to bear, the parts can be made comparatively light, the water value kept small (about 60 to 70 grammes), and a fairly large increase of temperature used. The sodium peroxide is actually melted by the heat, and this makes it easy to obtain complete combustion.

As the various parts of a calorimeter themselves absorb heat, it is necessary to find their absorption capacity in relation to water; this is called the water value of the apparatus, and may be found by multiplying the weights of the parts by their specific heats, or more accurately by making an experiment with a pure substance of known calorific value such as sugar carbon.

The sodium peroxide calorimeter consists of a combustion chamber suspended by a tube passing through the wooden top of the apparatus, and having a valve at the top of the tube; the bottom part of this chamber unscrews, and the coal is placed in it, sodium peroxide to the extent of 16 to 20 times the weight of the coal being added and well mixed with it; the combustion chamber is then screwed together and placed in the water vessel, which is of copper, and fits on to the wooden top with a bayonet joint, so that the whole can be lifted together. It is then placed in the outer insulating vessel, a thermometer graduated in twentieths of a degree Fah. is suspended in the water, and the apparatus is ready for firing. The water is well stirred, and the temperature is taken; a short piece of wire is made red-hot, dropped through the valve, and the valve closed. The combustion starts immediately, and is over in a few seconds. The ther-

mometer rises rapidly at first, and then more slowly, until it reaches its maximum in five or six minutes. The apparatus gives a direct reading, the thermometer rising 1° F. for every 1,000 B.TH.U.

As calorimeter experiments are always made with the coal dried at 220° F., and at ordinary temperatures, the result is the calorific value of the dry coal with the hydrogen burnt to water, but a more useful result is the calorific value of the coal as received with the hydrogen burnt to steam, which is obtained by making the following corrections. For example, supposing that, with a certain coal, 14,500 B.TH.U. was the result of the calorimeter experiment, and it was found that the coal contained 4 per cent. of hydrogen, and consequently produced 36·0 per cent. of water when burnt, it would be necessary to deduct 0·36 × 967 (latent heat of steam) = 348 B.TH.U., making 14,152 B.TH.U. for the dry coal with the hydrogen burnt to steam, and if 10·0 per cent. of moisture was contained in the coal as received, the 14,152 must be multiplied by 0·9, giving 12,736, from which must be deducted 0·1 × 967 = 97 B.TH.U., for the water in the coal, giving as a final result 12,639 B.TH.U. as the calorific value as received, with the hydrogen burnt to steam. The evaporative power from and at 212° F. is found by dividing the above result by 967, and gives the pounds of water that 1 lb. of coal would evaporate from and at 212° F., if all the heat could be used.

	Anthracite.	Hard steam coal.	Short flame with hard coke.
Volatile matter	6·45	12·74	21·42
Ash	3·96	10·18	6·26
Fixed carbon	89·59	77·08	72·32
	100·00	100·00	100·00
Moisture	2·36	1·14	3·42
Calorific value of dry coal burnt to water in B.TH.U.	14,920	13,910	14,690
Calorific value of coal as received burnt to steam in B.TH.U. ...	14,386	12,078	13,437
Evaporative power from and at 212° F.	14·9 lb.	12·5 lb.	13·9 lb.

	Furnace coal coking.	Long-flame coal, soft porous coke.	Non-coking long-flame gas coal.
Volatile matter	32·35	36·17	46·64
Ash	11·25	8·42	7·14
Fixed carbon	56·40	55·41	46·22
	100·00	100·00	100·00
Moisture	6·75	5·31	6·42
Calorific value of dry coal burnt to water in B.TH.U.	13,920	14,500	14,750
Calorific value of coal as received burnt to steam in B.TH.U.. ...	12,472	13,157	13,216
Evaporative power from and at 212° F.	12·9	13·6	13·7

The determination of volatile matter is made by heating 2 grammes of the coal in a closed platinum crucible to a red heat for 15 minutes, cooling, and finding the loss of weight; this also gives the amount of coke produced, that is, if the coal will coke; and the coke may be examined as to whether it is hard and dense or soft and porous, points which it is sometimes useful to know when using some types of mechanical stokers.

The method of sampling must necessarily vary according to circumstances, depending upon how, and in what quantities the coal is delivered, but the chief end to aim at is to obtain a sample that really represents the bulk, and this is usually done by taking every tenth or twentieth barrow, or whatever may be used in the unloading, mixing, breaking up the lumps and quartering again and again until a few pounds only are left containing no lumps that will not pass a ¼-in. sieve. Three or four bottles of from ½ to 1 lb. capacity are filled and sent to be tested or kept for reference; it is advisable to use bottles with tightly fitting corks, or patent tins, the tops of which can be covered with wax to prevent the escape of moisture.

It would be a good plan, in large stations, at any rate, to adopt similar methods to those used by smelters, steel works and other large users of coal, viz., to fix in the contract the limits of moisture and ash, and to make deductions in the price for any excess over the amounts allowed. In the ordinary way a coal merchant has a tendency to choose a sample to submit to the buyer that is a little above the average, and the bulk delivered will not be quite up to the sample. This may occur quite unintentionally through carelessness; but if it is found that deductions are made, more care will be taken to see that the bulk is up to the sample. Of course, it is impossible to say what the saving may be when this method is adopted, as there is no means of knowing what would have been delivered if the system had not been in force, but it must be remembered that each per cent. of ash or moisture means a ton in every 100 tons, and as a difference of 5 per cent. between the sample and the bulk is not an unusual occurrence, it will be seen that such systematic sampling and testing must effect a considerable saving.

It is very often found that a low priced coal is better value for the price asked, provided that the furnace is capable of burning it properly, as the price is not in direct ratio to the heat units contained in it, the higher priced coals being proportionately more expensive. In the previous column are given the actual figures for some typical coals.

BUSINESS NOTES.

Brush Contracts. — The following contracts have recently been placed with the BRUSH ELECTRICAL ENGINEERING CO., LTD. :—

For the Bombay Electric Supply and Tramways Co.—Five double-class cars with double bogie trucks and Brush motor equipments; five single-class cars with double bogie trucks and Brush motor equipments; 10 additional sets of trucks and motor equipments.

For the New Modderfontein Gold Mines, South Africa.—300 KW. Brush-Falcon enclosed engine.

For the Midland Railway Co. (for Burton and Ashby light railways).—Seven complete electric cars with Brush trucks and Westinghouse motor equipments.

Thomson-Houston Athletic Club. — The second annual athletic and cycling sports of this club under A.A.A. and N.C.U. rules, are to take place on Saturday next, August 18th, on the B.T.-H. Sports Ground at Rugby, when a very successful meeting is anticipated. Among other items on a very strong programme, there are two Midland Championships to be decided, viz.: the Long Jump and the One Mile Steeplechase. The present holder of the latter championship is Arthur Russell, a member of the Thomson-Houston A.C. Russell is also holder of the Two-Mile Steeplechase Championship of England. The entry list just closed shows that last year's record entry of 415 will be equalled if not exceeded, and among them are no less than 20 champions representing the South, Midlands and North of England, Ireland and Wales. Special arrangements have been made with the L. & N.W. Railway and the G.C. Railway for the issue of cheap tickets to Rugby on the day of the sports.

Catalogues and Lists.—The ELECTRIC AND GENERAL STORES CO., Leeds and Sunderland.—Circular showing and pricing a workshop tidy or assembling stand which they are supplying.

The HERCULES ELECTRICAL MANUFACTURING CO., Church Lane, Battersea.—Price list of ignition and storage batteries of from 12 to 1,500 ampere-hours capacity. The particulars are clearly set out in table form.

The C. W. HUNT CO., New York.—Pocket catalogue of their "Industrial" railways, special cars, track, &c.

MESSRS. MAVOR & COULSON, LTD., Glasgow.—The firm's August date card gives a record of a year's working of one of their electric coal cutters.

MESSRS. CLARKE, CHAPMAN & CO., LTD., Gateshead-on-Tyne.—Illustrated catalogue (46 pp.) describing by the aid of some good half-tone blocks and some coloured sectional diagrams, the "Woodeson" patent slow speed steam pumps for all services and pressures. Feed pumps with their automatic control gear, service and ballast pumps, tandem compound pumps, vertical and horizontal ram pumps are all particularised. There are some tables of useful general information concerning weights and measures, steam pressure, temperature, volume and density, and so on, of value in connection with the matter.

ADNIL ELECTRIC CO. (Marples, Leach & Co.), 6, Victoria Avenue, Bishopsgate Street Without, E.C.—Price-list (No. 103A) of 44 pp., giving general specification, also tabulated figures as to outputs, pressures, prices, dimensions and weights, of their various types of direct-current dynamos and motors. Illustrations are given, both half-tone and line, the latter including various diagrams of connections. A special list is given of motor-generators, also an illustrated description of their tramway-type controllers, which are extensively used in connection with electrically-driven printing presses and similar machines.

THE PERFECTA SEAMLESS STEEL TUBE AND CONDUIT CO., LTD., Aston.—Illustrated price list (8 pages) relating to the Perfecta continuity fittings, inspection and junction boxes, ceiling rose and switch boxes, &c.

MESSRS. CECIL HODGES & CO., Balfour House, Finsbury Pavement, E.C.—Leaflet relating to the patent "screened light" batten for special colour effects, which has been adopted in several theatres. The batten is fitted with reflectors, which prevent the mingling of lights of different colours, and increase the reflecting surface

Speedometer v. Police Evidence.— In a recent motor-car driving prosecution at Leeds, it was alleged by the police that the car covered a distance of 220 yards at the rate of 28 miles an hour. The car was provided with two speedometers supplied by Messrs. S. Smith & Son, Ltd., of Strand, W.C., one of which had a tell-tale hand thereon which indicated a speed of 19 miles per hour. Upon this evidence being given, the stipendiary magistrate suggested a test of the accuracy of the speedometers, which was duly carried out, and on their being found accurate, he dismissed the summons, stating that, in his judgment, a mechanical instrument of this kind was more reliable than the observation of police officers. Without casting any imputation upon their veracity, he remarked that the human element was more capable of error than a reliable instrument.

Country House Lighting.—A somewhat novel idea, with the object of developing the use of combined petrol engines and dynamos for country house lighting, has been put into practice by M. Delieuvin (204 Boulevard Pereise), Paris. This gentleman holds the concession for the De Dion electric lighting sets, and, with the view of bringing their advantages before possible users, he has mounted one of them on a small motor-car. The equipment comprises engine, dynamo, cables and switchboard, &c., so that the car can be driven to the residence of any possible client, and small temporary installations by way of demonstration carried out at short notice.

Annual Outing.—The annual outing of Messrs. A. Reyrolle & Co.'s Hebburn establishment took place on Saturday last in glorious weather. The morning was spent visiting the different historic spots of Alnwick. After dinner, which was provided at Alnwick, brakes were provided to drive the whole party to Alnmouth, where tea was provided on the Battery. The great success of the day was the sports, of which "putting the shot" and the singing competition proved the most exciting and enjoyable.

Book Notices.—*Projektierung von Elektricitätswerken.* By Fritz Hoppe. Vol. X of "Repetitorien der Elektrotechnik." Hanover: Dr. Max Jänecke. Price M.3.80.—To give anything approaching complete information on the design of electricity supply stations in the space allowed by this little volume is obviously impossib'e, and the writer has consequently confined himself to a general outline of the subject, based on the special information collected by him for a larger treatise about to be published. The question of cost is rightly made the deciding factor throughout, and the conditions which must be fulfilled before an undertaking can be called a success are clearly pointed out. The writer deplores the fact that so many German electrical supply undertakings are not a success financially, after deductions for depreciation, &c., have been made on a sound basis, and he considers that this is largely due to the want of careful preliminary calculation, the tendency towards showy and expensive buildings, and the low prices charged to power consumers, indiscriminately, in spite of the fact that they often add to, instead of reducing, the cost of production. The book is divided into five chapters, dealing respectively with Preliminary Investigations, Predetermination of the Cost of Production and the Probable Profits, Design of the Station and Selection of the Plant, Design of the Distributing System, and General Hints on the Preparation of the Scheme. There is also an appendix giving some useful statistics as to the cost of German undertakings. The information, though very much condensed, covers the whole ground, and is given in simple language, and in a form which will be readily understood even by the non-technical reader.

Aufnahme und Analyse von Wechselstromkurven. By Dr. Ernst Orlich. Vol. 7 of "Elektrotechnik in Einzel-Darstellungen." Brunswick: Friedrich Vieweg & Sohn. Price M.3.50.— The increasing importance given to the detailed study of alternating current curves of recent years, quite justifies the production of a book like this, giving a concise account of the various methods of experimentally recording and of analysing such curves. From the nature of the subject the treatment is necessarily somewhat mathematical, but the descriptions of the various methods are clear, though very much condensed, and are in many cases usefully illustrated by the writer's experiments at the Reichsanstalt. The three chief divisions of the book deal with (1) the experimental determination of the curves (including the numerous step by step methods, the Braun cathode tube method and the various oscillographs); (2) the experimental and mathematical methods of curve analysis; and (3) the different mechanical harmonic analysers. The first two of these divisions are complete and up to date, but the third, perhaps because of its comparatively small practical importance, is not sufficiently detailed or illustrated to give a clear idea as to the action of the various machines described. A useful table of references to original sources is added, and, wherever possible, the names of the makers of the various pieces of apparatus are given.

Die Akkumulatoren. By Dr. L. Lucas. Vol. VI of "Repetitorien der Elektrotechnik." Hanover: Dr. Max Jänecke. Price M.3.40. —This is a thoroughly practical book on accumulators, and contrives to give, in small space, an all-round view of their action and construction, without going into the multiplicity of manufacturing details. Part I deals with the raw materials employed and the standard methods of construction. In Part II the uses and methods of operating accumulators are explained, and descriptions of their auxiliary apparatus, switchboard arrangements, &c., are given. Short articles on portable batteries, alkaline accumulators and primary batteries are also included. Part III contains a simply worded introduction to electro-chemical theory, while Part IV deals with its application to the lead accumulator, and also gives some useful hints as to the sources of failure in accumulators. Frequent references to the standard works on the subject by Dolezalek, Gladstone and Hibbert, &c., as well as to the technical Press, add to the usefulness of the book.

Synchronmaschinen für Wechsel und Drehstrom. By W. Winkelmann. Vol. IV of "Repetitorien der Elektrotechnik." Hanover: Dr. Max Jänecke. Price M.3.40.—This volume deals with the electrical side of the design of single and three-phase alternators and synchronous motors. It is intended for those already possessing a fair general knowledge of the subject, so that many points are passed over shortly with a reference to Arnold's or to some other alternating current text-book. The treatment is somewhat unequal, a quite disproportionate amount of space being given to a discussion of E.M.F. waves and the production of a sine wave E.M.F. on open circuit, whilst the practical construction of the machines is hardly touched on at all. The subject of armature reaction is fully dealt with, and the chapters on the parallel running of alternators and on the compounding of alternators are clear and sufficient. The last 30 pages are devoted to the detailed electrical design of a 500-KW. three-phase alternator, and form a useful commentary on the rules laid down in the earlier part of the book. A short index is provided, as well as a table of the symbols employed, and a fairly complete table of references to recent articles on the subject in the German, English, American and French technical Press.

"Experimental-Untersuchung über die Möglichkeit einer Doppeltelephonie mittels unterbrochener Klänge. By J. W. Giltay. Amsterdam: J. Müller.

"Proceedings of the Engineers' Club of Philadelphia." Vol. XXIII, No. 3, July, 1906. Philadelphia, Pa.: The Club, 1122, Girard Street.

"Technology Quarterly and Proceedings of the Society of Arts." Vol. XIX, No. 2, June, 1906. Boston, Mass.: Massachusetts Institute of Technology.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXV, No. 7, July, 1906. New York: The Institute, 95, Liberty Street.

Dissolutions and Liquidations.—Llandudno and Colwyn Bay Electric Traction Co., Ltd.—Creditors must send particulars of their debts, &c., to Mr. J. Morris, 33, Brazennose Street, Manchester, the liquidator, by August 24th.

Messrs. G. H. Murphy & Co., general electrical engineers, 94, Bermondsey Wall, Bermondsey.—Messrs. G. H. Murphy and G. H. K. Hays have dissolved partnership. Mr. Murphy will continue the business under the old style, and will attend to debts.

Henry B. Binko, electrical engineer, Leadenhall Street, E.C.—Notice is given of the release, on July 2nd, of the trustee under this failure.

The Electrical Corporation, Ltd.—On August 4th this company resolved to wind up voluntarily, with Mr. E. Wilding, Dashwood House, E.C., as liquidator.

Empire Electric Light and Power Co., Ltd.—A petition presented by the Tudor Accumulator Co., Ltd., for winding up this company is to be heard in London on August 22nd.

W. R. Sykes Interlocking Signal Co.—A petition to confirm a resolution reducing the capital from £100,000 to £75,000, is to be heard on August 22nd.

Messrs. J. E. H. Andrew & Co., Ltd.—A meeting is to be held on September 18th at Sheffield to hear an account of the winding up from the liquidator (Mr. A. R. Bellamy).

Scottish House-to-House Electricity Co., Ltd.—This company is winding up voluntarily with Mr. H. B. Renwick as liquidator, the business being sold to the Coatbridge and Airdrie Electric Supply Co., Ltd.

General Electric Power and Traction Co., Ltd.—A meeting will be held at Dashwood House, E.C., on September 19th to hear an account of the winding up from the liquidators (Messrs. E. Wilding and W. Bullock).

Bankruptcy Proceedings.—Lazarus Blumenthal, electrical merchant, 78, Queen Victoria Street, E.C.—At the London Bankruptcy Court, on Monday, the statutory first meeting of creditors was held under this failure, Mr. E. Leadam Hough, the Senior Official Receiver, presiding. The receiving order was made on July 24th, upon a petition of Messrs. Krupka & Jacoby, the act of bankruptcy alleged being non-compliance with the requirements of a statutory bankruptcy notice. The chairman reported that, according to the debtor's statements, he was a German subject, and for many years prior to August, 1895, carried on business as a commission agent in the United States of America. He came to this country in March, 1896, having between £500 and £1,000 capital, with an invention for an improved telephonic system, patented by Baron Szvetic, of Buda-Pesth. In July of the following year he registered the News and Entertainments Telephone Syndicate, Ltd., with a nominal capital of £25,000, divided into shares of £1 each, for the purpose of acquiring his licence to use the patent. He sold the licence to the syndicate at the price of £15,000, payable in fully paid shares, and was appointed as managing director. He borrowed £1,250 for the purposes of the syndicate; that money was still owing by him. The syndicate carried on business at 78, Queen Victoria Street, E.C., but it failed in its attempt to obtain contracts for the supply of its system, and it ultimately became moribund. The debtor estimated that he had lost £1,775 in connection with the syndicate. In March, 1899, or 1900, he became agent for the sale of electrical motor-cars, manufactured by H. Scheele (of Cologne). The cars were invoiced to him at a fixed price, and he was allowed to retain any sum he received over and above that price. He carried on the

agency under the style of the Imprimir Motor-Car Co., until 1904, when it was transferred to the Automobile Supply Co., Ltd., on the understanding that he should continue the agency on behalf of the company, receiving a commission. He subsequently resigned that position, and had since been engaged in dealing in second-hand motor-cars. The debtor further stated that in 1903 he also began to deal in electric lamps and fittings, and he had carried on that business under the style of the Simplex Electrical Co., with the exception of the period December, 1903—April, 1904, when he carried on a similar business at 1A, Lancaster Gate, S.W., under the style of the Ajax Electrical Co. The claim of the petitioning creditor arose out of goods supplied to the Simplex Co. The debtor, who attributed his failure to loss in connection with Baron Szvetic's invention and want of capital, had filed a statement of affairs showing liabilities £2,477 4s. 2d., and assets *nil*. There was no proposal before the meeting, and the case remained in the hands of the Official Receiver, an order for the summary administration of the estate having been obtained. The public examination is appointed for September 11th. Appended is a list of the principal creditors:—

H. Cocks, Bartoum Gardens, W.	£250
Segar, Bastard & Co., Salter's Hall Court, E.C.	35
Doherty & Co., Great Newport Street, W.C.	10
J. Mason, Acton, W.	750
T. Lang, address unknown	350
H. Scheele, Cologne	850
F. Ferrington, address unknown	150
T. Ryall, Hill's Place, W.	30
Sweetmeat Automatic Co., Ltd., London, S.E.	35
Lancaster Garage, Lancaster Gate	75
H. Estd. Herrenau, Queen Street, E.C.	35
Krupka & Jacoby, Watling Street, E.C.	95

Trade Announcements.—The works of MESSRS. RICHARDSONS, WESTGARTH & CO., LTD., at Middlesbrough will be closed from to-morrow, 18th inst., until 27th inst., for stocktaking and local holidays.

From to-morrow, 18th inst., all communications for the YORKSHIRE ELECTRIC POWER CO. must be addressed to the new head offices, Thornhill, near Dewsbury.

MESSRS. SIEMENS BROS.' DYNAMO WORKS, LTD., inform us that they have opened a branch office at Central House, New Street, Birmingham, which will attend to their interests in the Counties of Leicestershire, Montgomeryshire, Northamptonshire, Rutlandshire, Shropshire, Staffordshire, Warwickshire and Worcestershire.

THE RUBEROID CO., LTD., of Waterloo House, 81-83, Knightrider Street, Queen Victoria Street, London, E.C., has been formed to take over the business of the "P. & B." and "Ruberoid" Departments of Messrs. Robert W. Blackwell & Co., Ltd. Mr. Edgar R. James, late joint managing director of Messrs. Robert W. Blackwell and Co., Ltd., is managing director of the new company, which will carry large stocks of the "P. & B." electrical compounds, tapes, varnishes and other electrical insulating materials.

Mr. H. MOSS, recently manager for Messrs. David Wilson & Co., Huddersfield, has been appointed manager of Department 2 for Mr. Chas. Pullan, electrical engineer and contractor, 57, King's Arcade, Bradford, to which address letters should be sent. Mr. Moss will deal with all business south of Bradford.

THE UNION ELECTRIC CO., LTD., ask us to mention that telegrams for them should be addressed "Abeam, London," "Abeam, Newcastle," or "Kandus, Glasgow." Telephonic communication to the head office, London, should be given through No. 2,970 Hop. They are particularly anxious that the trade should take a note of these arrangements.

LIGHTING and POWER NOTES.

Aldershot.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £2,000 for mains extensions and an amount overspent on capital account.

Barnstaple.—The annual accounts of the T.C. show that, in regard to the electricity undertaking, during the past year the revenue amounted to £3,994 and the working expenses to £2,107, leaving a gross profit of £1,887. Out of that sum the financial charges absorb £1,618, leaving a net surplus of £269 on the year's working. This has reduced the deficiency on the previous two years' working to £726. The sale of energy per meter realised £1,812, and for public lighting £1,789.

Basingstoke.—The Council has had under consideration correspondence relating to the sale of the prov. order for electric lighting to Messrs. Enright. The latter firm had offered £250 for the order, but the Electric Lighting Committee disagreed as to terms and the matter dropped. Now the Committee is anxious, owing to the lapse of time, to come to some arrangement.

Beverley.—The T.C. has considered the proposed terms of the agreement for the transfer of the electric lighting order to Messrs. J. and J. S. Enright, of London, and resolved to ascertain from Messrs. Enright the precise terms of the agreement they are prepared to enter into, particularly as regards the opening up of the streets, the period for the execution of the works and other matters.

Caversham.—The U.D.C. has decided not to consent to the application of the Electricity Works Development Co. for a prov. order for E.L., the Council having decided to apply for powers itself.

Bath.—The accounts of the City electricity undertaking for the year ended March 31st last, have been issued, and the result is rather disappointing. There was a deficit on the 1905 working of £214; this, however, was covered by the previous year's credit balance, and £937 carried forward. The deficit this year amounts to £339. The output only increased by some 60,000 units, and of this amount, 32,559 was due to public lighting. The total revenue received from supply of energy for power purposes was only £211. The charges are 5d., 4d. and 2½d. per unit for lighting, and 1⅞d. per unit for power. The principal items are as follows:—

Year ended March 31st,	1906.	1905.
Total revenue	£18,149	£17,883
Total working costs	£9,915	£9,238
Gross profit	£8,234	£8,145
Interest	£4,635	£4,523
Sinking fund	£3,938	£3,836
Net loss	£339	£214
Number of public lamps	193 arcs / 10 inc.	183 arcs
Units sold	1,050,588	989,407
Maximum load	919 KW.	916 KW.
Average price obtained per unit:—		
Private lighting	4·639d.	4·76d.
Public lighting	2·57d.	2·78d.
Total working costs per unit	2·26d.	2·24d.
Capital expended	£152,943	£146,311

Canada.—KENORA, ONT.—The Corporation has awarded to Messrs. Allis-Chalmers-Bullock, Ltd., Montreal, the contract for the municipal lighting plant, consisting of three A.C. generators, of the water-wheel type, each of 625 KW. capacity, and two direct current generators of 175 KW. each, to be used as exciters. The contract, includes switchboard and other accessories.

Continental Notes.—NORWAY.—A law is expected to be introduced into Norway's new Storthing to prevent the alienation of the country's waterfalls to foreign companies. A Norse speculator is said to be already in England seeking to form a strong English company with a view to controlling the largest number possible of his country's waterfalls. The sale has been arranged of Vrangfos and Eidfos, two of the largest waterfalls in Hollen, to Mr. Advocate Flood, of Christiania, on account of third parties, for a sum of 850,000 kroner. The ultimate purchaser is Mr. Chamberlain Cappler, of Ulefos, who contemplates using the falls for the generation of electric current for use in his iron smelting works in Hollen.

SWEDEN.—The Tyttbo waterfall, in Dalälf, belonging to the Gysinge Co., has been sold to Mr. G. A. Granström for 375,000 kroner, the latter proposing to utilise it for the generation of electrical power for his zinc smelting works at Sola.

The Riksdag has sanctioned the expenditure, for the benefit of the State, of 3,250,000 kroner for the erection of a power station, the building of a canal, and the acquisition of various private rights on the Trolhattan stream. Further sums, bringing the total up to 5,000,000 kroner, have also been sanctioned by the Riksdag for the State purchase of other waterfalls for the working of the Government electric railways.

ITALY.—A company styled the Società Elettrica del Pellino (Bergomanero) has been formed with a capital of 400,000 lire, to be increased to 1,000,000 lire, for the production and distribution of electrical energy in the Valley of Pellino.

Chingford.—The U.D.C. has decided to oppose the application of the Mutual Electricity Supply Co. for a prov. order for E.L.

Dundee.—At a meeting of the Electricity Committee on August 13th, the engineer, reporting on the question of a site for the new electrical station, brought under notice a proposal to acquire King William Dock. The cost, including sub-stations, he estimated at about £87,000, and while the initial cost might be heavy, it would be compensated for by the station being near the centre of the city. It was agreed to have a conference with the Harbour Trustees.

Durham County.—A conference of delegates of the Durham Miners' Association was held at Durham on the 11th inst., to consider the question of a county electrical supply service, and the general principle of municipalisation. No resolution was put, but there was a general agreement that the principal of municipal enterprise should be supported.

Ecuador.—The British Consul at Guagayuil reports that projects for electric light are being developed in Quito, Riobamba, Ambato and Latacunga, all to be worked by the abundant water-power of the country, but so far they are in a primitive and very incomplete state. At Loja, on the confines of Peru, electric light has been established for some years, but it is constantly getting out of order.

Exeter.—A L.G.B. inquiry was held on the 7th inst. relative to an application by the C.C. to borrow £15,500 for electric lighting works, &c. Considerable discussion took place in regard to portions of the proposed loans already spent, and the inquiry was adjourned pending the supply of further details.

Hereford.—The T.C. has decided to extend the electricity works and enlarge the plant, at an estimated cost of £6,250. The sum is made up as follows:—Boiler, feed pump, piping, &c., £1,178; condensing and feed water plant, £550; one triple-expansion engine direct coupled to a 250-KW. multi-polar shunt-wound dynamo, and one 60-KW. steam balancer set, cables, instruments, &c., £3,150; buildings, £1,000; contingencies, £372.

India.—KASHMIR.—*Indian Engineering* states that a decision has been arrived at by the Kashmir Durbar in the matter of the hydro-electric installation at Jummoo, tenders for which were called for last year. After careful consideration of all the tenders, H.H. the Maharaja has decided to accept that of Messrs. Balmer, Lawrie & Co., of Calcutta.

Ivybridge.—The U.D.C. has decided to discuss an E.L. scheme with an expert at an early date.

Japan.—According to the *Anglo-Japanese Gazette*, the Tokyo Electric Light Co. for the first half of the present year shows a net profit of Y340,264. The dividend is at the rate of 12 per cent. per annum, taking Y303,000. Y15,800 goes to reserve, and Y21,464 is carried to the next half-year's account.

The report of the Kyoto Electric Light Co. for the half-year shows a net profit of Y79,269, a dividend at the rate of 15 per cent. per annum absorbs Y75,000, Y4,000 was placed to reserve, and Y269 carried forward. The directors announced the issue of 7 per cent. debentures to the amount of Y300,000.

CHEMULPO.—The plant at the electricity works, which has been erected by a Japanese company, comprises two 175-H.P. horizontal tandem engines, driving two 100-KW. generators. The whole plant, including boilers, is of German manufacture.—*Anglo-Japanese Gazette.*

Kearsley.—The Farnworth U.D.C. and the Lancashire Electric Power Co. have informed the U.D.C. that they intend applying to the B. of T. for prov. orders for E.L.

Little Hulton.—At the meeting of the U.D.C. on August 8th, a letter was read from the Lancashire Electric Power Co., stating that arrangements were almost complete for the transfer of the Council's E.L. order.

London.—MARYLEBONE.—On its consulting engineer's advice, the B.C. offer to install and supply, through wiring contractors, no fewer than two pairs of 50-watt lamps to any new and approved customer for an inclusive charge of 20s. per lamp per annum, to cover the use of the wiring and the supply of electricity up to 1,500 hours a year. All new lamps are to be paid for by the consumer, and electricity consumed in excess of the quantity named is to cost 1d. per unit.

CAMBERWELL.—A special meeting of the B.C. has been convened for September 19th to consider the question of applying to the B.of T. for a prov. order to supply electricity for public and private purposes in the borough, but excluding the area of the South Metropolitan Electric Light and Power Co. within the district.

Newquay.—The generating station of the Newquay Electric Light and Power Co. was inaugurated a week or so ago. The ceremony was performed by the chairman of the U.D.C. The system is three-wire with 460 volts across the outers. Mr. A. S. Hawkins is the resident engineer.

New Zealand.—WAIHI.—In further reference to the Waihi Gold Mining Co.'s scheme for the utilisation of the Hora Hora Falls for the generation of electricity for power purposes on its properties, the Minister for Mines, Mr. J. McGowan, said a few weeks ago that the Government has not definitely refused the application, but is willing to allow the company to develop the falls subject to certain conditions being complied with.

WELLINGTON.—At the annual meeting of the council of Fire Underwriters' Associations of New Zealand, which was held in Wellington a short while ago, the subject of electrical installations received earnest consideration. In consequence of the large proportion of wooden buildings in New Zealand towns, the council decided that firm and united action must be observed in this matter, and that good work by contractors must be insisted upon; the defective work must be put right, and installations in every instance made to conform to the requirements of insurance companies before a certificate is granted; and, failing this, the insured must pay an additional rate of 5s. per cent. or his policy must be cancelled.

AUCKLAND.—The City Council has asked Mr. Goodman, of Dunedin, to take preliminary steps to call for tenders for the electric lighting of the city.

Ormesby.—In reply to a communication as to adopting electricity for public lighting, the U.D.C. has informed the Cleveland and South Durham Electric Power Co. that the matter will be considered when the transfer of the Ormesby E.L. Order to the company is completed.

Portsmouth.—A fire, supposedly due to spontaneous combustion, recently occurred in the coal stored in the bunkers at the Corporation Electric Lighting Works. Similar fires have frequently happened during the summer months at other stations, pointing to the necessity of adopting more efficient means of storing large quantities of fuel for considerable periods.

South Africa.—UMTATA.—The municipality, a short time ago, called for tenders for a complete installation for either acetylene gas or electric lighting for the town. For the latter, the Umtata waterfalls, about 2½ miles distant, are available, where there is permanent supply of water. The falls are 66 ft. deep. Power is required chiefly for lighting purposes. The number of lights estimated for either scheme is from 2,000 to 4,000.

St. Anne's-on-Sea.—The T.C. has decided to make application to the L.G.B. for a further loan of £6,000 for mains and service extensions.

South America.—CHILE.—A concession for providing electric light and power to Llai-Llai and district has been awarded to the Sociedad Fabrica de Sacos Roberto L. Beausire.

South Africa.—INDWE.—Capt. Quentrail's report on the local coal mines for 1905 states that electricity continues to be largely used there. About half the coal is cut with electric machines of the American chain type, and the principal haulage underground is by electric locomotives. Continuous current is used at a pressure of 450 volts, with an earth return. During the year an electric tramway over 2 miles in length has been constructed on the surface.

Scunthorpe.—The U.D.C. has offered to supply electricity to the Midland Ironstone Co. for power, at 3d. per unit.

Sowerby.—The P.C. has asked the Northern Counties Electricity Supply Co. and the Thirsk Gas Co. for prices for lighting the 73 public lamps for approximately 1,380 hours, the lights to be guaranteed at 40 C.P., and the last-named company to quote for incandescent burners for the whole of the lamps.

Sunderland.—At the meeting of the T.C. on the 8th inst., recommendations that a contract be entered into with Messrs. W. T. Doxford & Sons, Ltd., for the supply of electric energy to the whole of their works at Pallion; and that the following machinery be obtained and installed at Hylton Road station and at Doxford's sub-station at a total estimated cost of £16,450, and that the Finance Committee be requested to memorialise the Local Government Board for sanction to borrow the amount, were agreed to. The additional plant includes a steam alternator; motor-generators and switch-gear; battery and auxiliaries; high tension transmission cables. Alderman Bruce said that if the Council agreed to the recommendation to take over the whole of Messrs. Doxford's supply, it meant that in a year it would have an output of at least 9,000,000 units; the Committee had inserted a clause in the agreement to the effect that Messrs. Doxford should pay such a sum annually, whether the works were working or not, as would meet the capital charges for interest and sinking fund, and a certain proportion for other fixed charges. It would get the capital returned by the time the contract expired. Then there was another provision in the contract, that if the price of coal went up, the company must also pay a proportionate price per unit in addition to the contract price. The basis price of coal was 8s. 6d.; if it advanced, the firm would have the pay the advance, and if it fell, the firm would reap the benefit. At present the firm named were taking 633,400 units, and the Corporation received £2,892; if the present proposal was accepted by the Corporation, the firm would take 3,000,000, and the revenue would be £9,375.

Train Lighting in India.—Burma has adopted the Vicarino-Crawford system, and the report is very satisfactory. The Great Indian Peninsula Railway has just ordered 10 sets and the Rajputana Malwa R., worked by Bombay, Baroda and Central Indian Railway, has indented for eight. But as the new agent is apparently in favour of Stone's system, the issue as far as the latter company is concerned is complicated.—*Indian Engineering.*

Warrington.—The T.C. has reduced the price of energy for the tramways from 1·6d. to 1·5d. per unit.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—We give herewith in brief the results of the past two years' working of the Corporation tramways. It will be seen that the total revenue during 1905-6 increased by a small amount, and the working expenses decreased by about £1,700. There has been, during the past 12 months, a decrease in the car miles run but an increase in the number of passengers carried, resulting in an addition to receipts per car-mile of ·49d. The units used per car-mile during the past four years have steadily increased; in 1903 the figure was 1·054; 1904, 1·106; in 1905, 1·246; and in 1906, 1·306. Mr. R. S. Pilcher, the general manager, in his report states that much of the increase is due to the extra weight and resistance to wind pressure of the top-deck covered cars. Some top-deck covered cars are now being built, and on completion these will number 29 out of a total of 69 cars. The Aberdeen Suburban Tramways Co. run some cars over the Corporation system, the total mileage run by the company in 1905-6 being 111,861, which total is included in the figures given below:—

Year ended May 31st	1906.	1905.
Total revenue	£70,508	£70,431
Working costs—including management	40,684	42,393
Gross profit	29,824	28,038
Interest charges	11,061	10,882
Sinking fund	3,134	2,858
Net profit	15,629	14,298
Capital expenditure	345,348	348,416
Length of route	14·37	14·37
Car-miles	1,546,015	1,617,525
Passengers carried	17,222,967	17,142,896
Receipts per car-mile	10·95d.	10·46d
Working expenses per car-mile	6·31d.	

Blackpool.—During the recent holiday season the Blackpool tramways have yielded record receipts. On the Sunday before Bank Holiday the takings, in fares, amounted to £524, in round figures, as against £470 on the corresponding Sunday in 1905. The Bank Holiday traffic receipts were £764, or £150 more than on the August Bank Holiday of 1905. The one day's receipts equalled three weeks' receipts in the winter season in Blackpool.

Bournemouth.—The new line of the Corporation to Lower Parkstone was inspected on behalf of the B. of T. by Major E. Druitt on Friday last. The power to construct this line, which is about two miles in length, had been obtained by the British Electric Traction Co. On the amalgamation of the undertaking of the Poole Co. of the B.E.T.Co. as a result of arbitration between the Poole and Bournemouth Corporations, the Poole Corporation undertook the responsibility to construct the line, and it employed Mr. F. W. Lacey to prepare the plans, &c. The electrical work was entrusted to the Brush Co. The line starts from the junction of the Ashley and Poole Roads, Branksome, and runs to Poole Park Gates East, where it connects with the line to Bournemouth and Poole. After the inspection the line was opened for traffic.

Bradford.—A statement relating to the Corporation parcel department shows that the actual number of parcels carried during the first complete year the service has been in operation was 478,214, and the receipts were £4,035. The department has the Bradford agency for several London carriers, and it is now equipped for sending parcels to any part of the world at a through rate.—*Yorkshire Daily Observer.*

Canada.—Fort William, Ontario.—The T.C. has decided to lease for seven years to the Mount McKay and Kakabeka electric railway, the line which the municipality is to lay down in its district. The system is to connect up with the company's line to Kakabeka Falls.

Mr. Arthur Hickling, of London, England, has been visiting London, Ontario, in connection with the building of an electric railroad from St. Mary's to London. Mr. Hickling is a member of the syndicate which is to finance the new undertaking which will have a capital of $1,000,000. The St. Mary's municipal authorities are keen on having the road built as quickly as possible, and the town is willing to subscribe for $50,000 of stock. The preliminary surveys are completed, and it has been decided to erect a power house at St. Mary's at a cost of $100,000. As soon as the exact route is decided upon, it is expected that work will be commenced.

Continental Notes.—Holland.—The concession for an electric railway between Utrecht and Moarssen has been entrusted to Messrs. Van Eysden & Volker, Utrecht and Westzaar, North Holland.

Switzerland.—A project for a new trunk line to pass through the Bernese Alps, and connect at Brigue with the Simplon, is under consideration. The new line will include in its length of 56 km., 13½ km. of tunnel, and will be electrically worked.

Erith—Bexley Heath.—Mr. A. Coveney, the manager to the Erith U.D.C. tramways, has placed before the Bexley U.D.C. proposals for the through running of cars between the two districts. They are as follows: For power to run the Erith cars over the Bexley tracks from Northumberland Heath to the Broadway, the Erith U.D.C. will hand over to Bexley all moneys earned on its line, Bexley paying working expenses during the period cars are in its district, calculated upon a mileage basis, besides supplying energy, maintaining the track and overhead equipment; or instead of paying Bexley the net profits earned on its section, Erith to pay an agreed price for every journey run in the district, such sum to be based upon the present average profits from that section, the Bexley Council maintaining the track, overhead equipment, and providing energy; or the Councils to arrange for mutual running powers. The running authority to pay to the owning authority all receipts earned in one another's district. The Chairman of the Bexley E.L. and T. Committee stated that the matter had been referred to its own manager, and he had reported fully on the subject. The chairman said the Committee was unanimously of opinion that the proposals were not practicable. He informed the Council that possibly neither the Erith nor the Bexley tramways would be run at a profit, and that the returns recently issued showed that Bexley had been carrying considerably fewer passengers per week, yet it took more money.

For our own part, we are inclined to the belief that it would not be to Bexley's disadvantage to have through running with Erith; it would certainly be an advantage from the public point of view.

Folkestone.—We understand that, in regard to the Folkestone, Hythe and Sandgate tramways, it is proposed to adopt the Dolter surface-contact system, provided it is proved to be satisfactory in other towns.

Hampton Wick.—A deputation of residents waited on the U.D.C. on the 8th inst., and urged the Council to make strong representations to the L.U.T., Ltd., to abate the noise caused by the company's trams.

Halifax.—A meeting of the Halifax No. 2 Branch of the Amalgamated Association of Tramway and Vehicular Workers was held on the 10th inst. to receive the decision of the executive with respect to the application for permission to their members to hand in notices unless their demands for the reinstatement of Driver Chadwick, six days' holiday with pay, and an advance of wages to conductors and shedmen, were granted by the Tramways Committee. The meeting was informed that the executive recommended that the wages and holidays question be submitted to arbitration, and in respect to the dismissal of Driver Chadwick, the executive will support the branch provided 80 per cent. of the men are prepared to hand in their notices. A Sub-Committee has been appointed to make a final appeal to the Tramways Committee on the matter.

Harlesden.—The B. of T. inspection of the Harlesden section of the Middlesex C.C. tramways was held on the 10th inst.

Hastings.—The T.C. on August 3rd decided by 21 votes to 9 to allow the Tramway Co. to run tramcars on Sundays provided that no employé works more than six days a week.

Heywood.—The receipts on the Heap Bridge and Hopwood tramways were reported at the meeting of the B.C. a few days ago to be very satisfactory, having for the month of June been equal to 10·22d. per car-mile. The July returns, it was stated, were likewise good. It is strongly recommended that a through service from Bury to Rochdale *vid* Heywood should be started. The Heywood cars are already partly worked by the Bury Corporation and partly by that of Rochdale. The various authorities are agreed as to the desirability of a through service.

India.—Rangoon.—*Indian Engineering* says that it is hoped that the tramways being put down by Messrs. Darwood & Co. will be opened about the end of this month.

Lancashire and Yorkshire Railway.—At the meeting held in Manchester last week, Sir George Armytage (the chairman) made brief reference to developments of the line in the Liverpool district, pointing out that they were running a passenger service from Seaforth to Aintree on what was previously a goods line, which had now been electrified. They were now electrifying two more lines between Liverpool and Seaforth, and intended shortly to electrify the length from Aintree to Sandhills, *vid* Walton Junction, with a halt at Orrell Park; so that they would have a complete circular service from Liverpool to Aintree, *vid* Seaforth Junction and back to Liverpool by Walton Junction. They had now eight rail motors running, six more were to be built, and they intended to purchase motor-omnibuses to collect traffic.

Light Railway Orders.—The B. of T. has confirmed the Tottenham and Walthamstow and the Bath and Lansdown light railway orders.

L. & N.W. Railway.—In the course of his speech at the half-yearly meeting last week, Lord Stalbridge remarked that the time had arrived for them to give increased facilities, and more thoroughly to develop their London suburban traffic. Although they were giving a good service of trains between Watford and intermediate stations and Broad Street and Euston, they had not been able to put on such a service as was necessary for the encouragement of building, such as they found on other suburban lines, because to do so would seriously interfere with the working of the long-distance traffic. Even if the line could carry the additional traffic, which it would not, the experience of other companies showed that Euston Station, with any possible enlargements, would in a very short time be too small for the new traffic they might create. Notwithstanding all the circumstances, their suburban traffic had grown, and continued to grow. The serious problem they had had before them for some years had been how to relieve their main lines of some of their present suburban traffic, so as to give increased accommodation for their long-distance traffic, and also how properly to develop the suburban traffic, without causing great disturbance at Euston Station. They had a scheme which they believed to be the solution. It was to make an electric railway from Euston to Watford and neighbourhood, partly alongside and partly under the present main line, with a loop and local station under Euston Station, to serve not only their existing suburban stations, but several additional stations along the proposed route. By this means they would be enabled in the first place to relieve the main lines of a great deal of their present suburban traffic, improve the service from Watford to Broad Street, and give much-needed additional facilities for long-distance passenger and goods traffic; secondly, to give a more frequent service of suburban trains, thus encouraging the development of the land lying alongside the line, and create a new and profitable traffic; thirdly, by going under Euston Station with a loop, they would decrease rather than increase the suburban traffic passing through the present Euston Station, and be able to afford communication with the City and South London and Charing Cross, Euston and Hampstead Railways. This was not a competitive scheme in any way, but an endeavour to meet existing difficulties and to provide ample facilities in their own territory, and at the same time to add to the prosperity of the company. The shareholders would have another opportunity at the Wharncliffe meeting in February of considering the scheme in a concrete form.

London.—Dulwich.—Dissatisfaction is expressed in the district as to the fares and routes arranged for the L.C.C. cars which are to serve Dulwich. No cars at present are to run direct between Dulwich, Blackfriars, Westminster, or St. George's Church.

L.C.C.—Four more L.C.C. motormen were fined 5s. and 2s. costs each, on Tuesday, for exceeding the speed limit.

Islington.—The B.C. has re-affirmed its opposition to the proposal of the L.C.C. to adopt the overhead-trolley system for the borough.

Manchester.—At a meeting of the Corporation Tramways Committee, held last Tuesday, it was reported that applications to the Bucklow R.D.C. and the Ashton-on-Mersey U.D.C. for licenses for the running of motor-omnibuses as "feeders" in those localities to the Manchester tramways had been refused. The question of extending the Stretford and Sale tramway service to the Timperley boundary, by the new route, was considered, and it was decided to open the extension to-day (Friday). At present the Committee is unable to go forward with the line to Altrincham. The provisional order of the Altrincham U.D.C. has only just received the royal assent, and has not been handed to the Committee. It is hoped that the work may be proceeded with in a few weeks.

Newcastle-on-Tyne.—The accounts of the Corporation tramways for the year ended March 31st, 1906, have just been issued. Traffic revenue amounted to £192,655. The Tramways Committee received on account of public lighting £3,847, and £500 as the rents of shops, making the total receipts £196,996. The traffic receipts work out at 11·40d. per car-mile. The income for the year ended March 31st, 1905, was £197,493, an average of 10·96d. per car-mile, so that the decrease in the revenue this year has been £497, while the car-mile average has increased from 10·96d. to 11·66d., an increase of ·70d. The great feature in the report is the saving that has been effected in the expenditure, and which has practically turned the concern from an unprofitable undertaking to a paying one. Above £10,000 has been saved in regard to traffic expenses alone, as the appended table shows:—

	1905.	1906.	Decrease 1906.
Superintendence	£1,479	£1,042	£437
Wages of motormen and conductors	42,552	39,256	3,296
Wages of other traffic employés	5,288	4,146	1,942
Cleaning and oiling cars	7,978	5,860	2,118
Salting and sanding track	2,204	737	1,467
Fuel, light and water for depôts	751	648	103
Ticket checking, including inspectors' wages	4,640	3,865	775
Uniforms and badges	1,818	936	882
Miscellaneous	1,923	1,824	99
Total saving in traffic expenses			£10,419

Other economies have been effected also. Thus general expenses have declined from £17,330 to £15,630, and general repairs and maintenance have fallen from £22,533 to £18,552. The up-keep of permanent way has been reduced from £7,913 to £5,387, and cars from £10,186 to £9,295. Power expenses fell from £10,628 to £9,433, and maintenance and repairs at power and sub-stations from £14,855 to £12,394, but public lighting expenses advanced from £884 to £1,038. The total working expenses for the year just ended were £105,933, as compared with £124,339 last year, a saving of £18,405. Deducting the £105,933 total expenses from the £196,996 total income, a balance remains to be carried to net revenue account of £91,063. Additions of bank interest, &c., make the total balance £91,441. Interest on loans amounted to £33,652, sinking fund charges £33,209 and special charges £4,848, leaving a balance on the year's working of £19,732. From this amount £18,704 has been set aside to reserve and depreciation. Last year £6,294 was devoted to the reserve fund.

New Zealand.—Christchurch.—A Committee of the Tramway Board a month or so ago interviewed a representative of the City and Suburban Tramways Co. on the question of the sale of a portion of its system. The company has refused to sell only a part of its undertaking, and in consequence the City Council has decided to resort to arbitration on the matter.

A New Zealand paper states that the Finance Committee of the City Council reported on tenders for rails and sleepers as follows:—"For the delivery at the board's siding of 22,000 hardwood sleepers. The following tenders were received:—J. D. Wallace, Wellington (as agent for Pike & Co., Sydney), £3,747; T. E. Taylor, Christchurch, £3,930; Millar's West Australian hardwood, Christchurch, £5,500. The Committee accepted the lowest tender. The specifications for rails were: 1,000 tons undrilled rails with 26 pairs of points and crossings; 1,000 tons of drilled rails with the necessary fishplates and bolts, and points and crossings; special work for Cathedral Square. The object of getting alternative tenders for undrilled rails without fishplates, and drilled rails with fishplates, was that the Committee could consider the question of using Thermit welding instead of fishplates and copper bonds. The Committee accepted Messrs. Hadfield's tender of £1,480 for manganese points and crossings, and Messrs. Barrow's tender of £7,412 for 1,000 tons of rails. The Committee does not recommend that fishplates be ordered, as the engineer's report recommends that the Thermit welding process be used. In view of the financial position of the Board the order for special work for Cathedral Square was not placed."

Auckland.—In consequence of overcrowding, the City Council gave notice to the Auckland Electric Tramways Co. that it was not performing its obligations under the Deed of Delegation to furnish sufficient rolling stock, and added that the company must add to its existing stock one car not later than June 30th, 1906, four not later than July 31st, 1906, and three large cars not later than September 30th next. The local manager of the company informed the Council that five cars would be ready by the end of July, and it was proposed to obtain three more for service by December. The company has been asked by the Council to furnish plans of the new cars for consideration by the Finance Committee.

North-Eastern Railway.—At the half-yearly meeting last week the Right Hon. J. S. Wharton, who presided, briefly alluded to the electric train working in the Newcastle district. The success of that traffic continued, and in the past half-year they carried 300,000 more passengers than in the corresponding half of last year. They had in parts of their area seven motor-omnibuses, 16 motor-wagons and nine motor-char-à-bancs at work, and he believed they were a source of great comfort and benefit to the inhabitants of districts which had no other vehicles plying for hire. In some of those districts they had had petitions for the formation of light railways, but they found that they could not in those particular districts possibly pay, and that they would not be justified in spending the shareholders' money in that way. They had, therefore, tried motor-'buses, and he believed that as time went on they would be more and more successful. During the last year they had hit upon some of the weaknesses of the machinery of the 'buses, and he thought they would have fewer breakdowns in the future than they had had in the past. The motor-wagons had been of considerable assistance to the farmers in conveying small parcels of agricultural produce, which they would have had difficulty in conveying by their own horses and carts.

Rochester.—The cost of the Corporation electric tramway at Maidstone Road, Rochester, has been fixed at £11,819 5s. 7d., and upon this amount the Chatham and District Light Railway Co., which has leased the line, will pay Rochester Corporation a rental of £738 14s.

Sheffield.—The city has adopted a universal penny fare on its tramway system, which seems to yield very satisfactory results. A penny for three and three-quarter miles—the length of one of the routes—cannot be complained of as excessive. At the last meeting of the City Council a report was presented on the future maintenance of the lines and their equipment. It was decided to establish a renewals fund of £75,000 and to set aside each year towards renewals an amount equal to a penny per car-mile travelled, or between £26,000 and £27,000 a year. That sum, it is believed, will be sufficient, though it is pointed out that neither Sheffield nor any other city has yet had sufficient working experience to be able to fix an exact figure.

South Lancashire.—The Lancashire United Tramways Co. is hurrying forward the completion of its lines in Worsley and Swinton, and is preparing to link up Kearsley from Unity Brook to Newtown, Pendlebury, a distance of about 1½ miles; then there will be the construction of the lines from the Ellesmere Monument, Walkden, in a westerly direction to the Four Lane Ends, a distance of nearly 4 miles. This will complete the Lancashire United Tramways Co.'s network of tramways in southern Lancashire, connecting a large number of towns and villages, besides linking—with two or three changes—Manchester with Liverpool.

Stretford.—The proposal to run a service of motor-omnibuses between Stretford and Didsbury by the newly-formed company—the Manchester District Motor Omnibus Co.—is strongly opposed by local residents, the noise, dust, and vibration caused by this class of vehicle being the chief grounds of objection. At a meeting of the Stretford U.D.C. last week a proposal to grant six licences for motor-omnibuses on the Didsbury service met with a good deal of opposition. The consideration of the question was deferred.

U.S.A.—New York—Chicago.—The *Tribune* says that formal announcement of a project to build a double-track railroad from New York to Chicago, *vid* Pittsburg, at a cost of £30,000,000, will be made this week by the filing of papers for the consolidation of the three small Pennsylvania railroads. The plans provide for complete electrification. The road, which is to be finished in three years, will be shorter by 108 miles than the shortest railway route between New York and Chicago. The bulk of the money for the new line will be furnished by English and other foreign capitalists associated with Mr. Joseph Ramsey, ex-president of the Wabash Railroad.

Severe fighting seems to have been in progress during last week-end along the tracks of the Brooklyn Rapid Transit Co. to Coney Island. The company has been charging 10 cents in place of the customary 5-cent fare, and the public has refused to pay more than the usual sum, especially in view of the fact that Mr. Justice Gaynor, of the Supreme Court, decided that the company was acting illegally in charging double fares. The company refuses to accept the Judge's decision. On Tuesday the fight still continued. People refusing to pay were ejected, but police travel in the cars, and unnecessary violence was nominally prohibited. It is feared that the cars will be wrecked, and the question of militia guarding the tramway lines is being discussed. Attention is being called to the danger of a state of things which permit a public company to defy the decision of a judge.

Due to the heavy rainfall on August 7th, the underground railway from Worth Street to Canal Street was flooded, and a number of crowded trains brought to a standstill. Panic seized many passengers, and numbers walked through the flooded tunnels to the stations, fortunately without mishap from the electrical conductor rails.

(Continued on page 263.)

ELECTRICAL PLANT AT THE KING EDWARD BRIDGE, NEWCASTLE-ON-TYNE.

The King Edward Bridge on the North-Eastern Railway at Newcastle-on-Tyne, opened by the King on July 10th, presents some features of special interest to the electrical engineer, as it is the first great bridge in the construction of which electricity has been extensively employed.

The bridge was designed by Mr. C. A. Harrison, the chief engineer of the Northern section of the North-Eastern Railway, and constructed by the Cleveland Bridge and Engineering Co., Ltd., of Darlington, one of their directors —Mr. F. W. Davis —supervising the whole of the work.

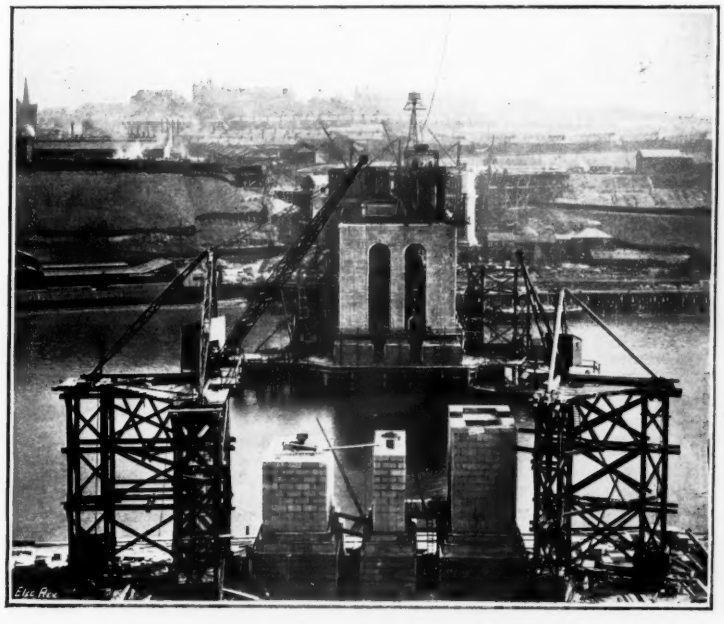


Fig. 1.—View of the King Edward Bridge under Construction, showing Electrical Cableway and Cranes.

A general view of the completed bridge is shown in fig. 2. The main portion of the bridge consists of four spans of steel girder work, 231, 300, 300 and 191 ft. long respectively, the total weight of steelwork being 5,782 tons.

The approaches consist of masonry arches, the total length of new work being 4 furlongs 2 chains. There are four lines of railway. The entire work was undertaken and carried out by the Cleveland Bridge Co., Ltd., no part being sublet, and the total cost somewhat exceeded £500,000.

The bridge crosses the river rather less than half a mile to the west of the high level bridge, and will enable trains from the south to enter Newcastle station at the west end instead of the east end as hitherto. Until now all trains from the South to the North and *vice versâ* have had to enter and leave Newcastle station at the east end, so that the engine has had to be changed from one end of the train to the other, and what was the rear of the train before reaching Newcastle became the front afterwards. This peculiarity in the working of the trains formed the basis of one of Luke Sharpe's humorous stories some years ago. He

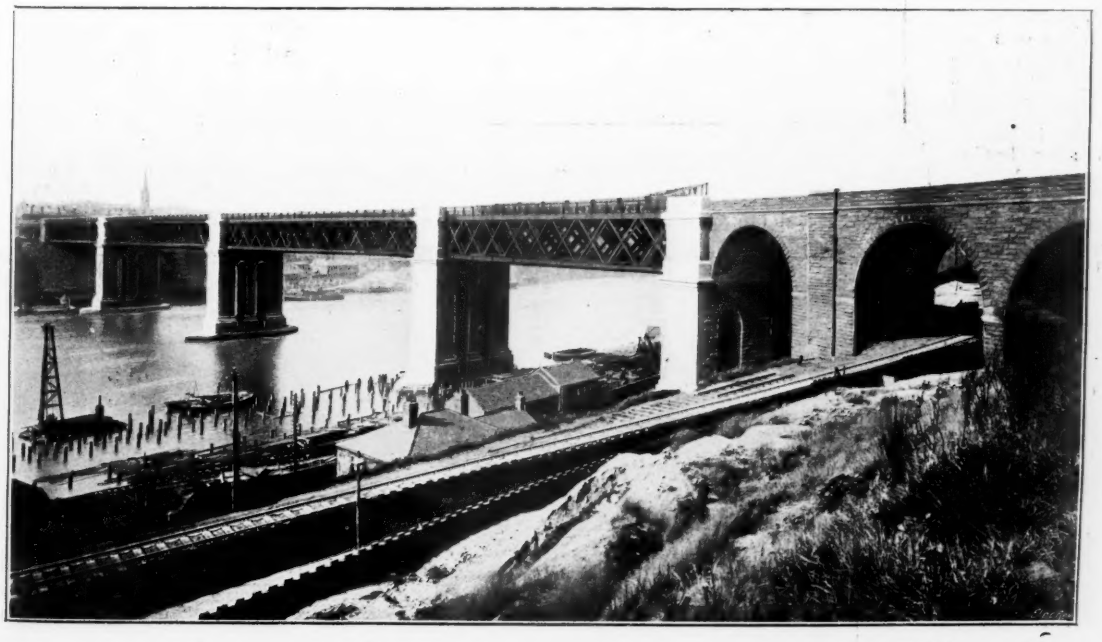


Fig. 2.—The King Edward Bridge, Newcastle-on-Tyne.

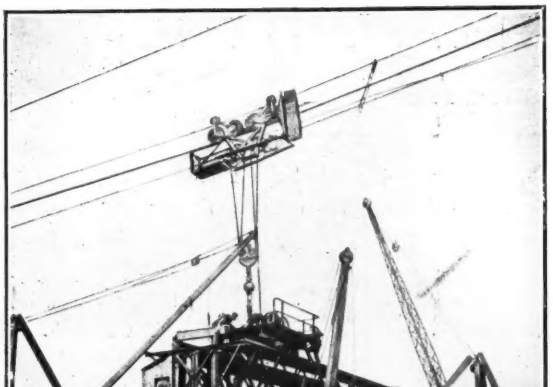


Fig. 3.—Setting the Crab on the Goliath Crane by means of the Cableway.

related that travelling North on a cold day in winter he had a seat facing the engine, while opposite to him was a passenger who insisted on the window being open. Finding protests unavailing and finding also that the passenger was going beyond Newcastle, Luke Sharpe allowed the window to remain open and tucked the leather strap down between the window and the door, ramming it down out of reach with his walking stick. The other man seemed puzzled at his procedure, but after leaving Newcastle he was enlightened when he found that he now faced the engine and got the full benefit of the winter blast.

Luke Sharpe explained the joke with a diagram, showing the course of the train into and out of Newcastle.

Having secured the contract, the Cleveland Bridge Co. decided that electricity should be used as largely as possible in the execution of the work, their experience of electricity on former contracts of smaller size having been most favourable. In 1897, on the strengthening of the Conway Tubular Bridge, a small electric plant was used for power and lighting. Electric lights were used with great advantage inside the caissons as well as in the open, and a specially designed electric hoist was used inside the caisson for hoisting up the spoil from the river bed and for moving the rock drills.

On the reconstruction of the viaduct over the estuary at Barmouth a similar small plant was used, while on the large contract for the rebuilding of Shrewsbury Station and construction of the new viaduct a more extended employment of electricity was ventured upon. In this case a generating plant of about 100 H.P. was put down, and numerous motors were employed for winches, cranes, and other machinery. Electricity was also employed on contracts at Brotherton, Gainsborough, &c., and from the experience thus gained the Cleveland Bridge Co. considered that both on the score of convenience and of cost, electricity should take a prominent part in the construction of the new bridge at Newcastle.

The contractor's offices and shops for the execution of the work were built on a plot of land on the Gateshead side of the Tyne, adjacent to the site of the new bridge. Here a generating station was also built, containing two Belliss-Crompton direct driving sets, each having an output of 750 amps. at 240 volts and 400 r.p.m. to supply energy for power, and three small 110-volt Robey-Phœnix sets which had been used on previous contracts, for lighting. Steam was supplied from five Ruston, Proctor locomotive boilers, this type being used as it had been found most satisfactory for contract work.

From the two power generators cables were led to a main switchboard made by Foxcroft & Duncan. This board was

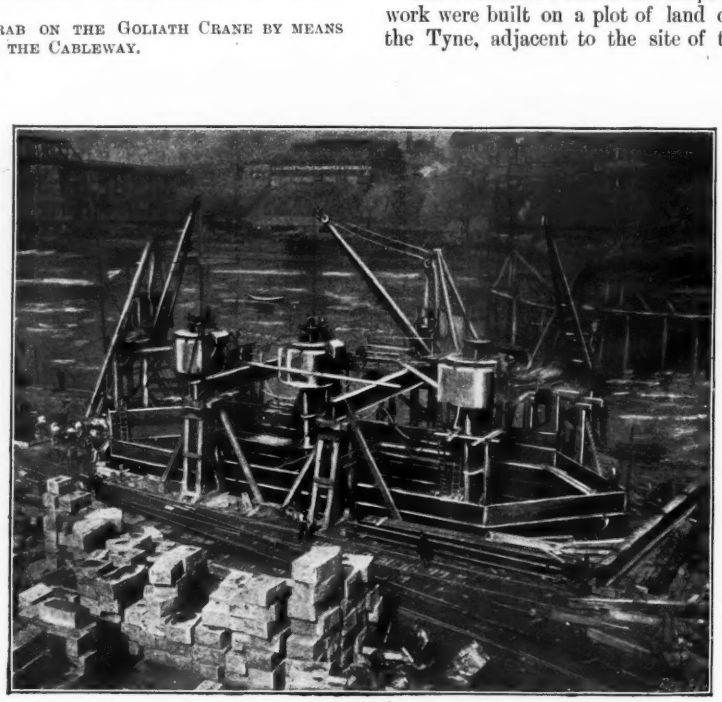


Fig. 4.—General View of Caisson.

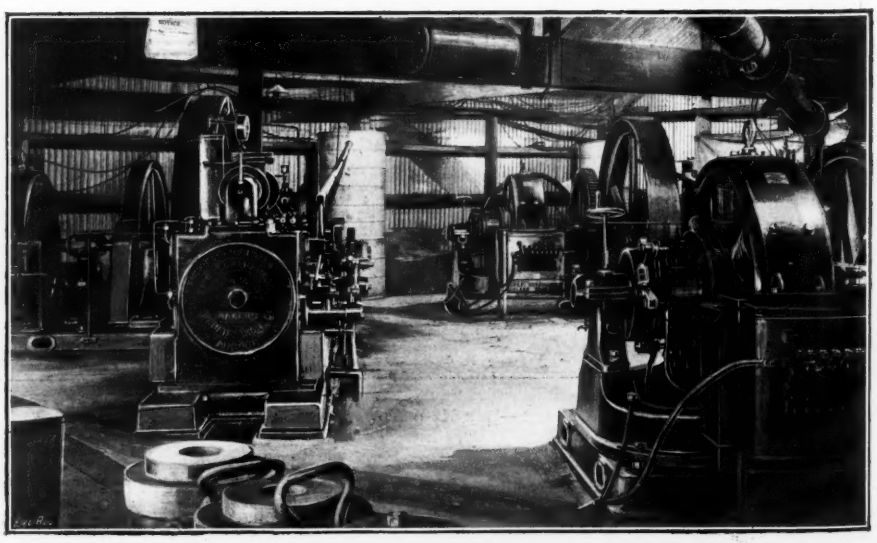


Fig. 5.—The Compressor Room.

arranged for the two generators to work in parallel, the usual circuit breakers, instruments and shunt regulators being provided. The whole output from the bus-bars passed through a 2,000-amp. electricity meter, beyond which the installation was divided into two circuits, viz., the caisson circuit and the general circuit.

In the caisson circuit a 1,200-amp. recorder was placed so that a continuous record might be obtained of the power required as the depth of the caisson and consequent pressure of air increased. The recorder was placed on the main switchboard and from it were led mains to a distribution board on the river staging, from which cables were led to the various caisson machines. To convey energy through the water, a twin cable with special insulation and extra heavy armouring was made by Siemens Bros. It was laid directly in the river without additional protection, and was quite satisfactory. The caissons were of unusually large size, being 113 ft. long and 35 ft. wide, the ends being pointed.

Each caisson was provided with three shafts and three air locks, and 35 men were employed in excavating in the chamber. Each shaft was served by a 5-ton electric derrick crane by Jessop & Appleby. The air locks, which were designed by Mr. F. W. Davis and patented by the Cleveland Bridge Co., were so arranged that the spoil buckets could be hoisted right up from the river bed and out of the air lock without being disconnected from the crane rope, and as the buckets were self-emptying, the spoil could be lifted from the river bed and delivered into barges alongside, without any intermediate handling whatever.

The air lock doors being heavy were, for convenience, operated by small electric motors. Fig. 4 shows one of the caissons with the electric cranes at work, while fig. 8 is an enlarged view of one of the cranes.

Compressed air was supplied by three Riedler compressors, having cylinders 15 in. diameter and 36 in. stroke, running at 90 r.p.m. Each of these compressors was driven, through cut steel gear, by a six-pole shunt motor of 125 B.H.P., made by J. P. Hall & Co., of Oldham. Fig. 5 is a view of the compressor room, showing the three compressors and motors.

On the general circuit the most interesting piece of

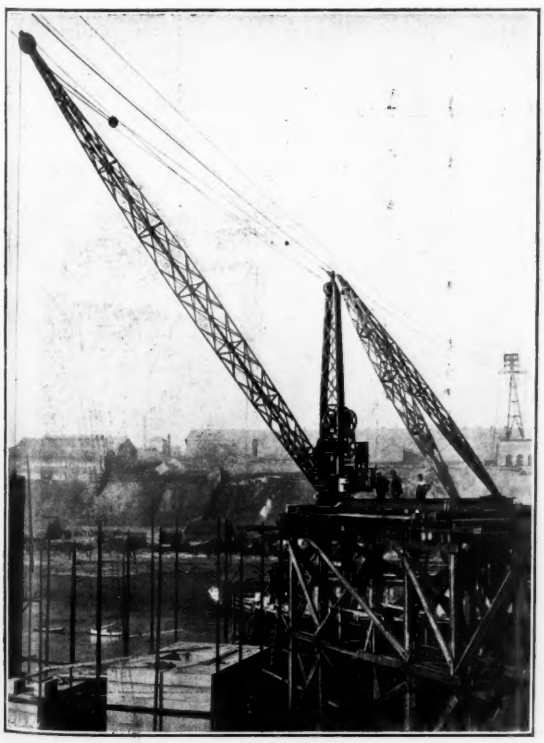


Fig. 6.—An Electrical Derrick Crane.

machinery was the cableway erected across the river for the purpose of conveying material to the river piers.

This was of exceptional size, having a span of 1,520 ft., and being capable of carrying 10-ton loads. The towers and anchorages for the main ropes were designed by Mr. Max am Ende; the whole of the machinery and electrical equip-

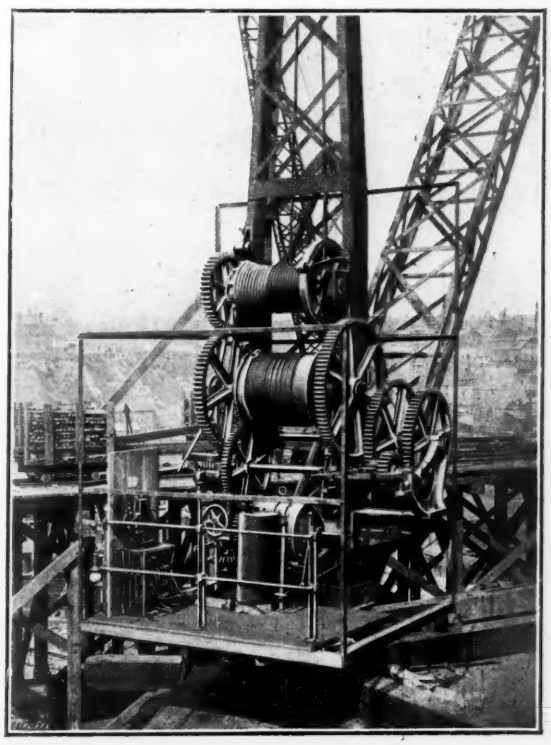


Fig. 7. View3of Electrical Gear on Derrick Crane.

ment being designed by Mr. Claude W. Hill, of Broad Street House, London, E.C. The cableway was constructed by the Cleveland Bridge Co., at their works at Darlington, with the exception of the winding gear, which latter was made for them by Ransomes & Rapier, of Ipswich. Several views of the cableway appear in our illustrations, while fig. 3 shows the cableway being used to put the crab in position on a 15-ton Goliath crane.

The speed of hoisting with full load was 75 ft. per min., and speed of travelling, 300 ft. per min., the winding gear being provided with change wheels, by means of which, for 5-ton loads, the speeds could be increased to 150 ft. and 600 ft. per min. respectively.

The main rope, made by T. & W. Smith, was 9½ in. in circumference, having six strands with 37 wires per strand, the diameter of the individual wires being 0·143 in. The stress on the main rope when unloaded was about 30 tons, and when loaded with 10 tons at the centre of the span, about 90 tons. The guaranteed breaking strain of the rope was 360 tons, thus allowing a factor of safety of about four, which is considerably higher than is usual in this class of work. This extra margin of safety was considered desirable owing to the peculiar position of the cableway.

A view of the winding gear is given in fig. 9. This was driven by a series crane motor of 100 B.H.P., and was provided with automatic electro-magnetic brakes, both on the hoisting and on the travelling motions. The brake on the hoisting motion was provided with a hand release, so that loads could be lowered on the brake without current on the motor.

The brake on the hoisting train was permanently in circuit with the motor, so that it released when the motor was started and renewed its grip when the motor was stopped. The travelling brake was brought into or out of the motor circuit by a switch operated by the lever of the travelling gear clutch, so that the one movement of the lever put the winch in or out of gear for travelling, and simultaneously effected the necessary change in the electrical connections.

The cableway carried nearly 40,000 tons of material, the travelling wheel rims being renewed once, and the rope being still in good order. When it was taken down the

Fig. 8.—A Caisson Crane.

rope was sold to Swan-Hunter and Wigham - Richardson for use at the launch of the new Cunarder *Mauritania*.

For setting the masonry several 5-ton electric derrick cranes were used, having jibs 70 ft. long; one is shown in figs. 6 and 7.

For erecting the steel girders, of which there were five in each span, each girder being 27 ft. deep and 4 ft. 6 in. wide across the flanges, a 15-ton electric Goliath was used, as shown in fig. 10. The hoisting motions of some of these cranes were fitted with shunt motors working regeneratively, as described in a previous number of the Review,* and in a paper at the Institution of Electrical Engineers† last session. These cranes gave more satisfactory results than those which were fitted with ordinary series motors.

In addition to the plant enumerated above, the concrete mixers, mortar mills centrifugal pumps, saws, mechanics' shops, &c., were driven electrically, the aggregate of motors employed on the work being nearly 1,000 H.P.

As already mentioned, the bridge was designed by Mr. C. A. Harrison, of the North-Eastern Railway, and he has been represented on the works by Mr. A. Cameron. For the Cleveland Bridge Co., Ltd., Mr. F. W. Davis has supervised the whole of the work, the resident engineer, until the beginning of the present year, being Mr. C. R. S. Kirkpatrick. Since Mr. Kirkpatrick's appointment to the city engineership of Newcastle-on-Tyne, his place has been taken by Mr. A. H. Walker. On the electrical work Mr. Claude W. Hill has acted as consulting engineer to the Cleveland Bridge Co.

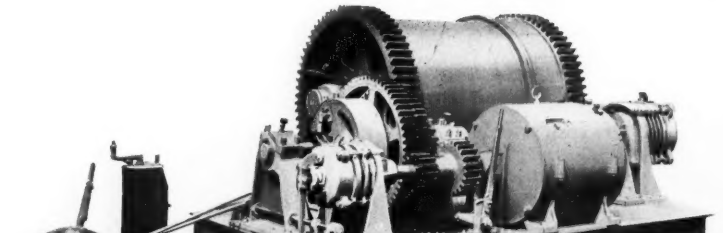


Fig. 9.—Electrical Winding Gear of Cableways.

Wood Pole Tests at Hull.—On Wednesday last week a series of important tests were carried out at Messrs. R. Wade, Sons and Co.'s Raven Street Yard, Hull, to ascertain the breaking strain and deflection and at a given load of wooden telegraph poles, and also any permanent set after the bending. The arrangements were made by Mr. Christopher Wade (director), and the tests were undertaken with the approval of the Board of Trade and by the desire of several large users both of ordinary telegraph poles and of those adapted for overhead electric power lines. The tests were made under the supervision of Prof. Goodman, of the Leeds University, and amongst others present were Mr. A. P. Trotter, electrical adviser to the Board of Trade; Mr. Hastings and Mr. Green, of Callender's Cable and Construction Co.; Mr. G. Morgan, Controller of the G.P.O.; Mr. Hy. Jackson, of the L. & Y. Railway; Mr. Ireland, of the G.N. Railway; Mr. Anderson and Mr. Vernier, of the Newcastle Electric Supply Co., Ltd.; and Mr. C. H. K. Chamen, Lancashire Electric Power Co., and many other interested parties were also invited to attend. The tests were carried out on double and single poles, and in one case a single 40-ft. pole was bent to the extent of 14 or 15 ft. out of the straight like a huge bow, before exhibiting signs of strain or fracture. The complete results of the tests will be embodied in a report, copies of which will shortly be ready. Several interesting photographs were taken during the proceedings, which were rudely interrupted more than once by heavy rain and a thunderstorm.

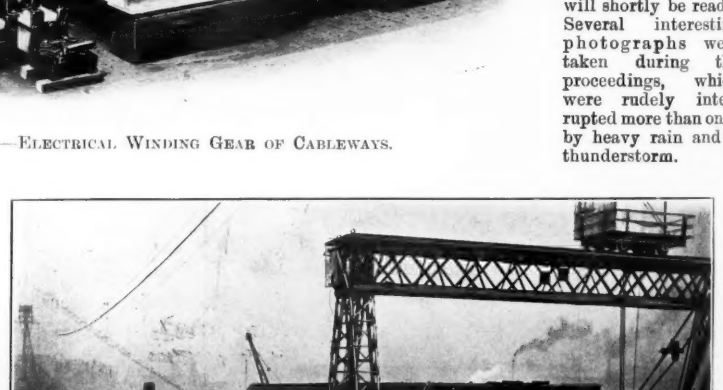


Fig. 10.—The 15-ton 55-ft. Span Electric Goliath Crane.

Chippenham Lighting.—A company has informed the T.C. that if the Corporation allows its E.L. order to lapse, the company will be prepared to refund a certain sum as compensation towards the costs incurred by the Council, and in addition to bear the entire cost of a new order. The offer is being considered by the E.L. Committee.

* See Elec. Rev., July 14th, 1905.
† See *Proc.* Inst. Elec. Eng., Vol. 36, Part 177, page 290.

TRAMWAY and RAILWAY NOTES.

(*Concluded from page* 258.)

Southport.—Among the means that have been suggested for improving the financial condition of the Corporation tramways undertaking is that of abolishing the issue of "contract" tickets, which it is argued are not remunerative. The Southport Tramways Co. has since approached the Corporation with a view to discontinuing "contracts," but the Corporation has decided that it cannot at present make the change.

Torquay.—At a meeting of the T.C. last week it was stated that the total cost of the new plant, &c., required to provide energy for the tramways, was £7,958, compared with £8,099 sanctioned by the L.G.B. It was stated that the electric cars would commence running shortly.

Walsall.—The T.C. has received the sanction of the B. of T. to an expenditure of £28,000, the estimated cost of reconstructing certain of the tramway lines in the borough.

Warrington.—The B. of T. has granted the T.C. a further (fifth) extension of time of a year for completing the tramways in the borough.

Wimbledon.—It is understood that the deadlock between the London United Tramways Co. and the T.C. has been ended, and that the Kingston-Wimbledon section will be opened as soon as the permission of the T.C. has been formally obtained.

TELEGRAPH and TELEPHONE NOTES.

Afghanistan.—It is reported from Kabul that the Amir has decided to establish telephonic communication between his various chief cities, and especially on the Russian frontier.

Australia.—A petition signed by 275 firms in Melbourne has been presented to the P.M.G. praying that permission be granted to the Pacific Cable Board and the Eastern Extension Co. to open offices in that city.

Canada.—The telegraph company which is controlled by the Canadian Pacific Railway Co. has outlined an extensive plan of expansion for the ensuing year. In all 7,000 miles of new telegraph lines will be erected. Of this total 4,000 miles will be put up in the Western Provinces of Canada, and will include an additional copper wire all the way from Winnipeg to Vancouver. The telegraph business of Canada is practically all done by two companies, one of which is controlled by the Canadian Pacific and the other by the Grand Trunk Railway.—*Financier.*

The Eastern Telephone Co., which controls the telephones on the island of Cape Breton, decided on 28th ult. to sell out to the Nova Scotia Telephone Co., of Halifax.

A telephone war is proceeding in New Brunswick between the New Brunswick Telephone Co. and the Central Co. The former has issued an order not to accept messages to or from the Central Co., except to St. John, Fredericton and Monckton, and then only to New Brunswick Co. subscribers. The Central Co. says it has a three-year contract with the New Brunswick Co., and it is probable that the matter will be threshed out in the law courts.

Ecuador.—The British Consul at Guayaquil in a recent report states that by a new agreement with the Central and South America Telegraph Co., a branch of their cable has been extended to the province of Esmeraldas. The same company, in return for a concession extending their privilege to 1955, offer to lay a short cable to place the Island of Puna, at the entrance of the Guayaquil River, in connection with the Government landline; but this offer has not been accepted, and a wireless system, Puna to Guayaquil, is now proposed, to be provided free of charge by the company. They also offer to connect the land telegraph from Guayaquil to Quito, by a cable, to be laid free by them, from the eastern to the western bank of the river.

Glasgow.—A memorial has been addressed by the staff of the Corporation Telephone Department to the Committee on the Telephone Service regarding the transfer to the Post Office. It is requested that the staff be transferred into grades at least equal to those they at present occupy, provided that if their present salary is the maximum of any grade they be admitted to the next grade; that those who become established servants of the Post Office entitled to a pension shall not forfeit their right to a pension though they may retire before having served 10 years under the Crown; and that any further concessions granted to the staff of any other licensees of the Post Office shall also apply to members of the Corporation staff.

Huddersfield.—The General Purposes Committee of the T.C. has agreed to allow the National Telephone Co. to lay its wires underground free of rental, but subject to terms to be arranged as to execution of works and other incidental matters. The company has, however, written, stating that after conferring with the secretary of the Post Office, it has arrived at the conclusion that it would be better for the Postmaster-General to provide the underground wires and lease them to the company.

India.—Telephonic communication on the East Indian Railway has been found to facilitate train working and communication between the staff, and arrangements are being made to provide 200 telephone instruments to supplement those already in use.—*Indian Engineering.*

Italy.—The British Consul at Naples reports that wireless telegraphy has been hailed with great satisfaction in Italy. The offices at Naples, Genoa, Venice and Monte Guiliano, as well as the one at Gibraltar, are all in touch with the principal ocean liners. It is expected that they will before long be opened to public use. Press telegrams can now be sent from Italy to the United Kingdom at 16 cents (about 1½d.) per word. The censorship on them as well as on private messages has been abolished.

The British Vice-Consul at Bari reports that one of the two pyramids for wireless telegraphy has been knocked down by storms, and the lighthouse tower, which stands close by, has been provisionally substituted. At Antivari, too, the station has been injured, and consequently the service has been subject to repeated interruption.

New Zealand.—The French Consul at Auckland in a recent report stated that the telegraph service of New Zealand possessed 7,944 miles of line with 23,704 miles of wire. In 1904, 5,159,745 messages were transmitted, the receipts being £167,581 13s. 7d. The number of telephone subscribers in March, 1905, amounted to 13,423, as against 12,105 in March, 1904. Subscriptions amounted in value to £79,061 7s. 4d.

Pacific Cable.—The report of the Board for the year ended March 31st has just been issued, and although it is pleasing to note that the receipts have increased, they have not done so in a manner which could be called satisfactory. The revenue figures are £91,952 (13 months' Australian receipts), against £87,446 in the preceding year. The number of words increased by 45,568, and it is to be hoped that the opening of new offices in Australia to compete with the Eastern Extension Telegraph Co. will greatly increase the revenue of the Cable Board. Owing to the refusal of the Eastern Extension Co. to accept the Commonwealth agreement as defined by the conference, the Commonwealth Government at once withdrew the privileges provisionally extended to the company at Melbourne, and accorded to the Board facilities in Sydney similar to those enjoyed by the company under the New South Wales agreement. The Board paid to the Canadian Pacific Railway and the Atlantic companies for the insertion of date and time and duplicate copies, the sum of £2,642 0s. 7d. The deficiency on the year's working of £72,556 1s. 9d. is shared in the following proportions, viz.: England and Canada £20,154 9s. 4d. each, Australia £24,185 7s. 3d., and New Zealand £8,061 15s. 9d. There will be a deficit for 1906-7, the Board calculates, of £87,006, after allowing for a revenue of £88,600 and a special expenditure of £8,000 in connection with the opening of offices and competitive tactics in Australia. It does not appear to us, however, that the opening of new offices is warranted at this expenditure if the traffic is to be less in consequence. An increased income must surely be secured when new offices are opened. The estimated traffic appears to us to be too low, unless, of course, the Board has been influenced by circumstances not mentioned in the report.

Post Office Telegraphs.—The annual report of the P.M.G., which has just been issued, shows that, during the year ended March 31st last, 89,478,000 telegrams were transmitted, an increase of ·57 per cent. The number of trunk telephone wire centres open on March 31st was 487, an increase of 44, and 151 new trunk circuits were provided, bringing the total up to 1,755. The number of conversations over the trunk wires was 17,974,000, an increase of 16·2 per cent. The capital expenditure on the trunk system up to March 31st was £2,897,503, a sum of £360,215 having been spent during the year. The gross revenue from the trunk service was £449,004, an increase of 17·6 per cent.

The total telegraph and telephone revenue for the year was £4,151,380, an increase of £231,357, and the expenditure was £4,906,087, an increase of £66,628. The net deficit on the joint service was therefore £754,707, or £164,729 less than in the previous year; but allowing for the interest on the capital expended on the purchase of the telegraphs, the telegraph deficit becomes £1,033,190.

The total number of subscribers to the Post Office telephone exchanges in the provinces was 8,425, an increase of 1,571, and the number of telephones rented increased from 8,644 to 10,380. The number of telephones connected with the London system of the Post Office increased from 24,351 to 32,879, and the year's working shows a surplus after meeting all charges; but there remains a deficit from previous years. Mention is made of the tentative use of high-speed automatic type-writing telegraphs, which has been fairly successful.

During the year the Post Office dealt with 11,652 Marconi messages, of which 558 were outward and 11,094 inward.

Contracts have been placed with the Marconi and De Forest Companies for installations between Tobermory and Loch Boisdale, in the Hebrides, and between Hunstanton and Skegness.

The total length of telephone wire belonging to the Post Office is now 128,000 miles; and in London 1,606 miles of underground duct have been laid, an increase of 355 miles.

Tibet.—The British Convention with China provides for the construction of telegraph lines connecting the three trade marts opened at Gyangtse, Gartock and Yatung under the Anglo-Tibetan treaty with India.

Spain.—The *Gaceta de Madrid* of June 30th contains copy of a decree appointing a Commission to report on the adoption of various measures for improving the Spanish telegraph and telephone services. The Commission is to report within three months from the above date, in order that the necessary reforms may be begun as soon as possible.—*Board of Trade Journal.*

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901 ..	..
Dominica-Martinique	May 7, 1902 ..	..
St. Lucia-Martinique	May 7, 1902 ..	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
Port Arthur-Chifu (Closed)	Mar. 7, 1904 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Garachico (Tenerif)-Santa Cruz	July 12, 1906 ..	..
Bolamo-Bissao	July 24, 1906 ..	..
Curacao-La Guayra } Closed	Jan. 11, 1906 ..	..
Curacao-Coro }		
Rhodes-Sitici	Aug. 10, 1906 ..	..
Falmouth-Bilbao	Aug. 14, 1906 ..	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902 ..	..
Bachkale-Deliman	Feb. 12, 1906 ..	..
Bagdad-Bassorah	July 17, 1906 ..	..

United States.—New York City.—Seven experts appointed by Col. G. B. McClellan, Mayor of New York City, are now travelling round the United States to gather information as to the advantages or disadvantages of competitive telephone services. Telephone service applications are outstanding from two new competing companies.

Wireless Telegraphy.—Wireless telegraphy has been established between the Cross Sands lightships and Caistor-on-Sea, which is connected by telephone with many other lifeboat stations on the East Coast.

It is reported that wireless telegraphy has been installed on many trains in Italy on Prof. del Vecchio's system.

The Canadian Government is extending the organisation of Marconi stations which has been established for communication with ships and from point to point along the coast. One of the new stations is to be at Father Point and one at Seven Islands, in the Province of Quebec. The station at Cape Race, which is an important point at the south of Newfoundland, is being enlarged. The contracts for this work have been given to the Marconi Wireless Telegraph Co., of Canada, which has constructed and works all the Canadian Government stations. When the two new stations are completed there will be a continuous Marconi system from Quebec to Labrador on the one side, and to Cape Race on the other.

CONTRACTS OPEN and CLOSED.

OPEN.

Belgium.—The municipal authorities of Ixelles-les-Bruxelles are about to invite tenders for the supply of 20 arc lamps and 4,575 metres run of armoured cables.

Bolton.—August 30th. Three-phase extra-high-tension switchboard for the Corporation. See "Official Notices" to-day.

Dublin.—August 20th. S.D. copper feed-water pipes for Pigeon House generating station for the Lighting Committee. Specifications from city electrical engineer (one guinea).

Edinburgh.—September 12th. Electrical wiring and fittings for the Police Fire Station, at Stockbridge. See "Official Notices" to-day.

Epsom.—August 31st. One 300-KW. steam dynamo, water-tube boiler, condenser, induced-draught apparatus, for the U.D.C. electric lighting extensions. See "Official Notices" to-day.

Germany.—The municipal authorities of Fulda are about to invite tenders for the establishment of a central electric lighting station in the town, at an estimated cost of £22,500.

Handsworth.—September 15th. Electric wiring for the Council's new schools. See "Official Notices" August 10th.

Osaka.—The *Anglo-Japanese Gazette* says that during the next few months the Municipality of Osaka will be in the market for various descriptions of electric railway plant, including passenger cars, rails, posts for overhead wires and engines. The contract will amount to close on Y1,500,000.

St. Pancras.—September 5th. One 2,000-KW. steam turbo-generator, switchboard, condensing plant, &c.; two 500-KW. three-phase motors coupled to continuous-current generators, switchboards, &c., for the Borough Council. See "Official Notices" to-day.

Spain.—The municipal authorities of Guardo (Valencia province) have just invited tenders for the concession for the electric lighting of the town during a period of six years.

Stoke-upon-Trent.—September 5th. Electric wiring of workhouse premises. See "Official Notices" to-day.

Weston-super-Mare.—August 22nd. The Electric Supply Co. wants tenders for cables, joint boxes, feeder pillars, &c. See "Official Notices" August 10th.

Woolwich.—Rearrangement of part of Plumstead Infirmary electrical installation for the Union. See "Official Notices" to-day.

CLOSED.

Devonport.—The Tramways Committee of the T.C. has accepted the tender of Messrs. Walter Scott, Ltd., for the supply of rails, at £7 per ton, and fish-plates and anchors, at £8 10s. per ton, and that of Hadfield's Steel Foundry Co., Ltd., for tie-bars, at £36 15s.

Dublin.—Messrs. Handley and Shanks, electrical and general engineers, Dawson Street, have secured a considerable portion of the contract for the lighting of the Bank of Ireland. Their contract includes the fitting-up of a large switchboard and sub-distribution boards, and the laying of underground mains.

Dundee.—The Corporation has ordered six car-bodies from the Brush Electrical Engineering Co., Ltd.

France.—The French Post and Telegraph authorities in Paris have just placed contracts as follows:—M. Grammont, of Pont de Cheruy, 5 kilometres of telephone cable, at 3,850 fr. per kilometre; Messrs. Aborlard & Co., Paris, 10 kilometres ditto, at 3,800 fr. per kilometre; and La Société Industrielle des Téléphones, Paris, 20 kilometres ditto, at 3,750 fr. per kilometre.

Taunton.—The Borough Education Committee has accepted the tender of Messrs. Stansell & Sons for installing the E.L. at the North Town Schools, at £199 13s.

NOTES.

Lord Kelvin on Radium.—In a letter to the *Times* of August 9th, Lord Kelvin takes exception to the theory as to the production of helium from radium and the transmutation of the elements, which is now generally accepted. He considers that "an isolated experimental discovery by Sir William Ramsay and Prof. Soddy . . . suggests nothing more towards any modification of the atomic doctrine . . . than does Ramsay's original discovery of helium as an emanation from the mineral clevite. The obvious conclusion from the two discoveries is that clevite and radium both contain helium."

Lord Kelvin proceeds to protest against the hypothesis that the heat of the sun or earth is due to radium, retaining his opinion that it is mainly due to gravitation.

As might be expected, Prof. H. E. Armstrong hastened to thank Lord Kelvin in the *Times* for his "timely and outspoken protest," describing physicists as "strangely innocent workers," and asserting that workers in the radium school appeared to have substituted pure imagination for caution. "The most crack-brained of hypotheses" and "the wildest of dreams" are amongst the terms used in this somewhat intemperate letter.

In the *Times* of the 15th inst., Sir Oliver Lodge comes to the aid of the radium theory. While paying a respectful tribute to the importance of Lord Kelvin's opinion, he summarises the evidence for the generation of helium, and expresses the view that it is extremely weighty. As regards the sun, he admits that gravitational energy is quite sufficient to account for the whole of its heat emission—*if the sun is actually shrinking at the prescribed rate;* but as regards the earth, he points out that Lord Kelvin himself guarded his deduction by a reservation which is now satisfied by the radium phenomena. Referring to Prof. Armstrong's effusion, Sir Oliver suggests that he and others who scorn chemical results obtained by physical means, preferring their own "odd and unconvincing" methods of reasoning, manage to absorb the said results in the end.

The Hon. R. J. Strutt also discusses Lord Kelvin's letter, pointing out that if all helium is removed from a sample of radium, after an interval a further supply can be extracted, and this can only be due to the generation of helium; further, the proportion of radium in the earth's crust is so large that unless that crust is very thin, it is difficult to say what becomes of the heat generated by the radium present.

Niagara Falls Power Development.—Our correspondent at Niagara Falls writes:—Inasmuch as the Burton Bill went into effect when passed by Congress and signed by the President, the U.S. Secretary of War has seen the advisability of issuing temporary permits to such companies as are developing power at Niagara Falls, or transmitting electricity from the Canadian side into the United States. These permits, as stated, are temporary, and are given to cover the existing conditions, and in order that the companies may not violate the law. The Niagara Falls Power Co. is granted a permit to withdraw 8,600 cb. ft. of water per second, and the Niagara Falls Hydraulic Power and Manufacturing Co. is granted a temporary permit to withdraw 4,000 cb. ft. per second until further order by the Secretary of War. To the Lockport Hydraulic Co. a permit has been issued allowing that company to withdraw 500 cb. ft. of water from the Erie Canal, and for the use of 333 cb. ft. from the lower level of the same canal at Lockport, the idea being that these two amounts are duplications, and that a future permit for 500 cb. ft. per second will cover them both.

In regard to the transmission of power from Canada to the United States, the Secretary admits having received applications for the transmission of 281,500 H.P., and says:—"It is necessary that the Secretary of War should know, before final action is taken by him in the matter of permits for transmission, the capital already invested in Canadian companies, the degree of completion of the plant, the amount of current likely to be sold on the Canadian side, the time when the plant shall be ready for operation, the amount now actually transmitted to the United States, the amount invested not only in the production of current, but in the plant and machinery for its transmission, including the poles and wires and all the details, and also the capital invested by the American companies who are to receive in the first instance the current thus produced, the form in which that capital is, and the contracts into which they have entered both with the Canadian companies and with the companies or persons to whom they expect to sell the current, the dates of these contracts, and all the circumstances tending to show the extent of the injury that a refusal to grant the permits requested would cause to the investment of capital, together with the question of when the contracts were made upon which the claims for the use of the current are based, with a view of determining the good faith with which these contracts were entered into, and whether the threatened passage of the law induced their making." Capt. W. Kutz, of the Corps of Engineers, has been appointed to make an investigation upon all the above questions.

However, temporary permits have been granted to two companies in the matter of transmission. The Niagara Falls Power Co. is granted a permit to take not more than 25,000 H.P. from the Canadian Niagara Power Co., and the Niagara, Lockport and Ontario Power Co. is authorised to take not more than 25,000 H.P. from the Ontario Power Co.

In Niagara Falls it is considered very likely that the Niagara Falls Hydraulic Power and Manufacturing Co. will get a permit for the additional 2,400 cb. ft. it will require to supply its new power house and installation, just as soon as it is prepared to use the additional amount of water.

Electric Prison Guards.—The roof of the Middlesex County Gaol, New Brunswick, N.J., U.S.A., has been protected by a network of bare conductors connected with the arc lighting circuits, with a view of preventing the escape of prisoners.

Copper Mining in Japan.—According to recent advices, says the *Financial News*, the copper mining industry of Japan is in a very prosperous condition, and the production of the important mines is rapidly increasing. The chief feature of the recent history is the remarkable development of the Kosaka Mine, in the northern part of the Island of Nippon, originally worked as a silver mine. Three kinds of ore are mined and smelted in six furnaces, each 3 ft. 5 in. by 25 ft. at the tuyeres. These furnaces reduce the charge at the rate of about 3 tons per sq. ft. of hearth area per 24 hours. A new furnace, 3 ft. 5 in. by 60 ft., is now being erected. The product of the blast furnaces is a lead-copper matte, containing about 30 per cent. copper. This is crushed, roasted and smelted for blister copper in reverberatory furnaces. The blister copper is refined electrolytically, and the capacity of the refinery is now being increased so as to take care of the entire product of the works. The Kosaka Mine has now displaced the famous Ashio Mine from the premier position among Japanese copper producers. Its output last year was approximately 7,200 tons of copper, against 6,600 tons from the Ashio Mine and 5,500 tons from the Besshi Mine.

Liquid Solder.—A new patent soldering paste called "Tinol" is being introduced into this country by Mr. Gustavus Feldt, of 50 and 51, Fore Street, E.C., for which valuable properties are claimed. The paste is entirely free from acid, and consists only of the pure solder and flux; it is applied to the joint to be soldered or surface to be tinned with a brush or spatula, and the work is then heated with a spirit lamp, soldering bit, or even, in the case of small wires, a match, when the solder readily flows into the joint. It is claimed that it is economical, as no solder is wasted, convenient, always ready, expeditious and strong, and it is usually unnecessary to clean the surfaces to be joined. All the usual metals can be soldered with it, and it is made in three alloys melting at temperatures of 240°, 213° and 180° C. respectively, each grade being further sub-divided according to the fluidity desired. Certain brands marked "W" are specially recommended for soldering tin-plate. We have tried the paste, and found it very handy and effective, and we understand that it is very widely used in Germany.

Electric Coal Cranes on the Clyde.—Two huge electric coal cranes of a novel design are being erected at the new Clydebank Dock, near Glasgow, a German firm has the contract, and Sir William Arrol & Co., Ltd., of Glasgow, are carrying out the construction work for the Hamburg patentees. The Clyde

ELECTRIC COAL CRANE AT THE CLYDEBANK DOCK.

Trust engineer, meantime withholds details, as the cranes being of an entirely novel character, he wishes to have them first in thorough working order before any description is put into circulation. Their principal features are the height and ease of working the largest wagons.

Electric Shock Fatalities.—A boy named Thackeray was killed by coming into contact with the conductor rail on the North-Eastern Railway near Dalton Street, Byker, Newcastle-on-Tyne, on Saturday afternoon. He was severely burned about the face, hands and neck. At the inquest it was stated that the child left home on Saturday afternoon to play. He, along with others, had gone to gather flowers in a field beside the railway, and had climbed over the wall of the bridge which spans the line between Dalton Street and Albion Row. Another lad, aged nine, who had his hands and legs swathed in bandages, told how he and some other children, including the deceased, got over the wall to gather flowers. The boy Thackeray was crossing the line, when he suddenly fell with his neck across the line, and commenced to cry. Witness tried to pull him off the line, but got his hands and legs burned in the attempt. Deceased was subsequently removed from the line by a passer-by, who, hearing shouts, was attracted to the spot. A verdict to the effect that the boy was accidentally killed through coming into contact with the "live" rail while trespassing on the railway was returned.

On August 8th, a fore overman, employed at the Dean and Chapter Colliery, Ferryhill (Bolckow, Vaughan & Co.), lost his life through receiving an electric shock. It seems that two boys had been playing near the depôts, and had got hold of one of the stay wires on the posts to which the electric wires are connected. The wires had by some means come into contact. Deceased (Wm. Walton), who was going from the colliery to his home, saw the boys were fast, and ran and pulled them off, receiving a shock which proved fatal. Drs. Shirlaw and Sealy were quickly on the spot, and resorted to artificial respiration but were unsuccessful. After a considerable time they were successful in bringing round the boys. Walton leaves a widow and four children.

Accident.—The *Yorkshire Daily Observer* says that on 8th inst., whilst two electricians, named Thomas Beaumont and Loftus Page, were working on a switchboard at the Bradford electricity works in Valley Road, a loud explosion occurred, due, it is understood, to a short-circuit, and the men were severely burned about the head and face. They were conveyed to the Royal Infirmary and detained.

Will.—The will of the late Sir Thomas Richardson, vice-chairman of Richardsons, Westgarth & Co., Ltd., and a director of the County of Durham Electrical Power Distribution Co., Ltd., and the Northern Counties Electricity Supply Co., Ltd., has been proved at £138,507 gross.

Appointment Vacant.—First assistant electrical engineer for the Corporation of Mansfield (£140).

Fatal Accident at Niagara Falls.—A regrettable accident occurred on 28th ult., at Niagara Falls, N.Y., when Mr. Samuel Weil, the superintendent of the Electrical Reduction Co., of Niagara Falls, while working about the switchboard came into contact with a live wire and received a shock at 2,200 volts. He lived only about an hour after the shock, although medical assistance was immediately forthcoming and every effort was made to save his life. Mr. Weil, although only 35 years of age, had been employed as superintendent for some years, and was popular on all sides.

Toy Telegraphs in Cuba.—Advices from Havana, Cuba, under date of July 16th, report that three Americans, including a young woman, were arrested and imprisoned for violating an old military regulation prohibiting other than Government telegraph lines. The three young people, for their own amusement, had constructed a toy telegraph line about ¼ mile in length between two residences. Each offender was sentenced to 33 days' imprisonment.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—From Australian papers to hand it appears that there has been some trouble in the Sydney Municipal Council respecting the appointment of a power house superintendent. From the *Australian Mining Standard* we gather that the matter was referred to the city electrical engineer, Mr. T. E. ROOKE, and the town clerk, and they were instructed to make a selection of the men most fitted to fill the position. Six names were submitted by them, but the Council went outside their recommendations and appointed Mr. S. BELLAMY. Mr. Rooke submitted a report drawing attention to the gravity of the issues raised by the fact that the Council had entirely disregarded the recommendations made. He declined to accept any responsibility for any results of their action. In appointing Mr. Bellamy an injustice had also been done to other members of the staff, of whom Mr. VINE HALL was the first. He had not the experience which he (Mr. Rooke) desired to obtain in appointing a power house superintendent, and realising this, Mr. Hall refrained from applying for the position, but he was much better qualified than Mr. Bellamy. Without any wish to reflect on Mr. Bellamy's ability as a rising engineer, he ventured to believe that his experience was totally inadequate to the Council's requirements, and not nearly equal to that of other men who would be his juniors in the service. The report was considered by the Electric Lighting Committee, and on the casting vote of the chairman a motion was carried rescinding the appointment of Mr. Bellamy, and asking the Council to reconsider the whole question of the appointment of a power house superintendent.

The Taunton T.C. has increased the salary of Mr. WALES, chief assistant engineer at the electricity works, from £150 to £175 per annum.

Mr. J. FIDDES BROWN, M.I.E.E., M.I.Mech.E., having accepted the post of engineer to the Buenos Ayres and Lacroze Tramways Co, has resigned the appointment he has held for some eight years as superintendent engineer to the Charing Cross, West End and City Electricity Supply Co. He is leaving this country about the end of the month for South America.

Mr. E. P. AUSTIN has been promoted to the position of deputy borough electrical engineer and tramways manager at Chesterfield, which post was made vacant by the resignation of Mr. H. L. Percy.

At the meeting of the Sunderland T.C. last week, when the matter of appointing a successor to Mr. J. F. C. SNELL was under consideration, Alderman Bruce said he thought it was general information that Mr. Snell had definitely decided that under no circumstances whatever would he continue his relationship with municipal corporations. He had definitely decided to enter the front ranks of his profession as a consulting engineer. He had not the slightest doubt that in the course of a year or two he would receive that support from the general community which would warrant him having taken the step which he proposed to do. From time to time he had used his influence to retain Mr. Snell, as during the period he had been with them his engagement had been varied. He had promised on behalf of the Council to increase his salary by any reasonable sum in order to retain him, but he had definitely decided to go. On the wish of Mr. Snell the Committee recommended the Council to agree to Mr. Snell being allowed from January to devote half of his time to the Corporation and half of it to his private practice, but foregoing one half of his half-year's salary. The Council would want Mr. Snell's successor at least three months before his time expired, in order that the new engineer might have the benefit of three months' conference with Mr. Snell before he took over the sole responsibility. Under ordinary circumstances, they would have paid the new engineer full salary and Mr. Snell full salary for three months, but Mr. Snell's half salary for six months was only equivalent to his full salary for three months.

A proposal was before a recent meeting of the Johannesburg Council for the engagement of Mr. J. F. I. THOMAS, as the general manager of the Tramways and Lighting Department, to be extended after the period of one year's engagement just completed, at a salary of £1,750 per annum.

Tramway Officials.—The Tramways Committee of the Walsall T.C. has recommended that the salary of the tramway manager be increased from £250 to £300 per annum, from October 1st, 1906.

The Wolverhampton T.C. has resolved to advance the salary of Mr. LUNTLEY, the tramways manager, by annual increments of £25, until a maximum of £350 is reached.

General.—Friends of Mr. C. R. D. PRITCHETT (who has charge of the London office of Messrs. Pritchetts & Gold) will learn with regret that he recently lost his wife.

It is announced that Mr. W. E. MANDELICK has been appointed secretary of the Baker Street and Waterloo Railway Co., in place of Mr. E. B. READ, resigned.

Our Toronto correspondent writes: "Mr. CECIL B. SMITH, consulting electrical engineer of Toronto, has been engaged by the municipal authorities of Winnipeg to superintend the construction of the Winnipeg civic power plant at a salary of $10,000 for 2½ years. Mr. Smith is at present chairman of the Temiskaming and Northern Ontario Railway Commission, and consulting engineer to the recently constituted Hydro-Electric Power Commission of Ontario. The new appointment will involve Mr. Smith's resignation of his position on the Temiskaming Railway Board, and possibly his connection with the Hydro-Electric Power Commission, as it is reported that in terms of the agreement with the Winnipeg authorities, Mr. Smith will only be allowed to act as consulting engineer to the Power Commission for a period not exceeding three weeks in each year. Mr. Smith is both well known and popular in Canadian electrical circles, and has been identified in the past with some of the large electrical undertakings at Niagara Falls."

Mr. F. S. MILLER, A.M.I.E.E., has left 20, Victoria Street, London, to join Messrs. H. P. Saunderson & Co., of the Elstow Works, Bedford, as a managing director.

NEW COMPANIES REGISTERED.

Lytham Electric Light and Power Co., Ltd. (89,766).—This company was registered on August 3rd, with a capital of £20,000 in £1 shares, to carry on at Lytham and elsewhere the business of suppliers of electricity for light, heat, motive power or otherwise, electricians, mechanical engineers, manufacturers of and dealers in electrical apparatus, &c., and to adopt an agreement with Foot & Milne, Ltd., for the transfer of the undertaking and powers granted by the Board of Trade under the Electric Lighting Acts to the said company pursuant to the Lytham Electric Lighting Order, 1905, and the Electric Lighting Orders Confirmation (No. 6) Act, 1905. The first subscribers (each with one share) are:—M. Robinson, Featherstone, Lytham, architect; A. Coulthard, The Star Hills, Lytham, cotton spinner; H. Foote, 46, Gillingham Street, S.W., electrical engineer; E. J. Owen, 52, Shaftesbury Avenue, W., electrical engineer; L. Milne, 69, Overstrand Mansions, S.W., electrical engineer; K. P. J. Jolivard, 41, Lyndhurst Road, Thornton Heath, accountant; and E. E. Smith, 66, Victoria Street, S.W., secretary. The number of directors is not to be less than two or more than seven; the first are M. Robinson, A. Coulthard, H. Foote, E. J. Owen, L. Milne, K. P. J. Jolivard and E. E. Smith; qualification, £200; remuneration, £100 per annum and a further £200, payable out of the surplus profits remaining after 5 per cent. dividend has been paid, divisible.

I.T.E. Electric Co., Ltd. (89,782).—This company was registered on August 7th, with a capital of £5,000 in £1 shares, to carry on the business of electricans, mechanical engineers and manufacturers, producers and suppliers of electricity, motive power and light, &c., and to adopt an agreement with W. E. Gibson. The first subscribers (each with one share) are:—F. W. Jeboult, 9, Walbrook, E.C., solicitor; S. H. Sawyer, 7A, Laurence Pountney Hill, E.C., chartered accountant; F. A. Caddick, 7A, Laurence Pountney Hill, E.C., chartered accountant; C. H. Cottle, 95, Harefield Road, Wimbledon, S.W., clerk; W. E. Gibson, 20, Great Russell Street, W.C., electrical engineer; D. H. Williamson, Lanehurst, Woodfood Green, clerk; and S. J. Suiston, 98, Cicada Road, Wandsworth, clerk. No initial public issue. The number of directors is not to be less than two or more than seven; the first are A. E. Newton, W. M. Scott and E. M. Dobelbower (all of Philadelphia, and all permanent), and W. E. Gibson, of London; qualification of permanent directors, 10 shares; none required for ordinary directors; remuneration as fixed by the company. Registered office 20, Great Russell St., W.C.

South American Development and Construction Syndicate, Ltd. (89,791).—This company was registered on August 7th, with a capital of £20,000 in £1 shares, to construct, work, develop and control public works and conveniences of all kinds, to manufacture or produce electric light, gas and other illuminants and steam or electric power, to erect machinery or apparatus for applying and turning to account any wind, water or other power, &c. The first subscribers (each with one share) are:—T. M. de Bingham, 78, King Street, Manchester, engineer; A. Castano, Euston Hotel, London, engineer; F. C. Sanders, 9, Farmilo Road, Leyton, clerk; G. Josephson, 4, Birkbeck Grove, Acton Vale, W., agent; Lord Danvers, 1, Broad Street Place, E.C.; G. Graham, 30c, Buer Road, Fulham, master mariner; and H. A. Harris, 86, Grove Park Terrace, Chiswick, W., clerk. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; remuneration as fixed by the company.

Beaumont and Still Colonial and Foreign Train Lighting Co., Ltd. (89,745).—This company was registered on August 3rd, with a capital of £18,000 in £1 shares, to acquire from M. W. W. Mackie, E. J. Glyn, A. R. M. Lockwood, F. J. Beaumont and W. M. Still, the benefit of certain existing inventions relating to improvements in electric dynamos and the lighting of railway carriages and tother vehicles by dynamos on such a system that the variable speed of the train or coach drives a dynamo at a varying speed, but such dynamo is self-regulating, to adopt an agreement with the said vendors, and to carry on the business of electricians, electric lighting and mechanical engineers, dynamo manufacturers, suppliers of electricity, &c. The first subscribers (each with one share) are:—F. J. Beaumont, 21, Albany Road, Stroud Green, N., engineer; W. M. Still, 24, Charles Street, Hatton Garden, E.C., metal worker; S. H. Cable, 20, Charles Street, Hatton Garden, E.C., accountant; F. G. Still, 24, Charles Street, Hatton Garden, E.C., metal worker; W. C. Still, 24, Charles Street, Hatton Garden, E.C., metal worker; E. J. Glyn, Newland Lodge, Ingatestone, electrical engineer; and M. W. W. Mackie, 45, Warwick Road, Ealing, electrical engineer. No initial public issue. The number of directors is not to be less than two or more than five; the first are E. J. Glyn, W. G. Richards, M. W. W. Mackie, F. J. Beaumont and W. M. Still; qualification, £250; remuneration as fixed by the company. Registered office, 24, Charles Street, Hatton Garden, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Century Arc Light Co., Ltd. (67,849).—This company's annual return was filed on June 1st, when 14,306 ordinary and 5,000 preference shares had been taken up out of a nominal capital of £30,000 in 25,000 ordinary and 5,000 preference shares of £1 each; £1 per share has been called up on 2,506, resulting in the receipt of £2,506; £16,800 is considered as paid on 11,800 ordinary and 5,000 preference. Mortgages and charges: £7,500.

Wolverhampton District Electric Tramways, Ltd. (68,345).—This company's annual return was filed on August 1st, when 32,200 shares had been taken up out of a nominal capital of £200,000 in 40,000 shares of £5 each; £5 per share has been called up on 31,950 and 5s. per share on 250, resulting in the receipt of £159,812 10s. Mortgages and charges: £100,000.

China and Japan Telephone and Electric Co., Ltd. (17,831).—This company's annual return was filed on July 10th, when 14,761 shares had been taken up out of a nominal capital of £20,000 in £1 shares; £14,761 is considered as paid. Mortgages and charges: £12,500.

West African Telegraph Co., Ltd. (21,626).—This company's annual return was filed on June 19th, when 23,109 shares had been taken up out of a nominal capital of £400,000 in 40,000 shares of £10 each. £231,090 has been received. Mortgages and charges: Nil.

Electrical Power Storage Co., Ltd. (30,313).—This company's annual return was filed on August 1st, when 18,592 ordinary and 66 founders' shares had been taken up out of a nominal capital of £100,500 in 20,000 ordinary and 100 founders' shares of £5 each. £5 per share has been called up on 66 founders', and £4 per share on 3,132 ordinary, resulting in the receipt of £13,332 5s. 1d., including £474 5s. 1d. paid on four founders' and 405 ordinary shares forfeited. £77,300 is considered as paid on 15,460 ordinary shares. Mortgages and charges: £28,400.

Callender's Cable and Construction Co., Ltd. (48,915).—This company's annual return, made up to May 24th, was filed on July 6th. 35,000 ordinary and 40,000 preference shares have been taken up out of a nominal capital of £500,000 in 60,000 ordinary and 40,000 preference shares of £5 each. £5 per share has been called up on 15,000 ordinary and 40,000 preference and £275,000 has been received. £100,000 is considered as paid on 20,000 ordinary. Mortgages and charges: £300,000.

James & Browne, Ltd. (72,372).—This company's annual return was filed on July 14th, when 20,000 shares had been taken up out of a nominal capital of £30,000 in £1 shares. £15,610 has been received, and £4,390 is considered as paid. Mortgages and charges: £2,200. Issue on July 12th of £300, and on July 26th, of £800 5 per cent. debentures, part of series created July 29th, 1906, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: J. W. Ellis, Portland House, Basinghall Street, E.C.; and E. Hughes, 106, Holland Road, Kensington. Previously issued of same series: £1,900.

British Electrical Tool Co., Ltd. (Leeds), (89,294).—£500 6 per cent. debentures, created and dated July 28th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—Issue on July 26th of £150 5 per cent. debentures, part of series created June 1st, 1904, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £650.

Frank Sufer & Co., Ltd. (electrical engineers, London) (57,198).—A memorandum of satisfaction in full of debentures dated April 18th, 1901, securing £5,000, has been filed. £1,000 6 per cent. second mortgage debentures, created and dated July 31st, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have also been registered. No trustees. Holder: J. Singlehurst, 84, Princes Road, Liverpool.

South Metropolitan Electric Light and Power Co., Ltd. (47,875).—Issue on July 27th of £17,968 4½ per cent. debentures, part of series created by resolutions of July 3rd, 1900, and May 6th, 1904, to secure not more than the amount of the paid up share capital. Property charged: The company's undertaking and property, present and future, including uncalled capital (if any). Trustees: H. R. Beeton, 18, Austin Friars, E.C.; and W. R. Davies, 10, Moorgate Street, E.C. Previously issued of same series: £22,000. The debentures are issued to the trustee, as further security for debenture stock created by trust deeds of August 3rd, 1900, and June 3rd, 1904.

African Direct Telegraph Co., Ltd. (21,895).—This company's annual return was filed on June 16th, when 23,600 shares had been taken up out of a nominal capital of £300,000 in 30,000 shares of £10 each. £236,000 has been received. Mortgages and charges: £36,600.

South African Lighting Association, Ltd. (27,609).—This company's annual return was filed on June 21st, when 8,900 shares had been taken up out of a nominal capital of £100,000 in £10 shares. £10 per share has been called up on 7,895 shares, and £78,950 has been received. £1,050 is considered as paid on 105 shares. Mortgages and charges: £80,000.

ELECTRIC TRAMWAY ACCOUNTS.

Manchester Corporation Tramways.

The returns of the Manchester tramways undertaking on a slightly increased track-mileage compared with 1905, exhibit considerable increases in traffic and receipts. The average working expenditure continues to creep up, although neglecting energy cost, its amount (5d. per car-mile) is well within economical limits.

General Statement.

For 12 months ending March 31st	1906.	1905.
Length of route	87 miles.	84 miles.
Total length of track	151⅛ „	146¼ „
Car-miles run	14,655,908	14,123,124
Passengers carried per annum... ...	133,923,932	126,900,875
Capital expended to date	£1,675,812	£1,587,931
Traffic receipts	£661,806	£628,529
Total receipts	£663,707	£631,955
Working expenses	£433,561	£411,597
Gross profit	£230,146	£220,358
Income per car-mile	10·87d.	10·73d.
Working expenses per car-mile ...	7·10d.	6·99d.
Interest and sinking fund per car-mile	1·44d.	1·49d.
Rental of leased lines, &c.	·29d.	·18d.
Total expenses per car-mile	8·83d.	8·66d.
Profit or loss per car-mile	2·04d.	2·07d.
Cost of energy per car-mile	2·09d.	1·99d.
Average fare per passenger	1·19d.	1·19d.
Revenue per mile of route	£7,628	£7,523
Expenditure per mile of route ...	£4,984	£4,899
Total units used	22,164,445	18,854,240
Units used per car-mile	1·53	1·33
Percentage of working ex'es to receipts	65%	65%

The energy cost per car-mile at over 2d., is undoubtedly heavy, and on its sales of 22 million units to the tramways, at 1·385d. per unit, the electricity department is surely doing a very profitable business.

On the year's working the gross profit is some £10,000 in advance of the 1905 total.

The 87 miles of route worked by the Corporation, includes 19½ leased miles, and 4½ miles over which the department exercises running powers. Details of the working expenditure per car-mile, are as follows:—

Traffic expenses		3·10d.
General expenses		1·00d.
General repairs and maintenance—		
Permanent way	·17d.	
Electrical equipment of line	·10d.	
Buildings and fixtures	·034d.	
Machinery and plant	·011d.	
Cars	·577d.	
Other rolling stock...	·018d.	
		·91d.
Power expenses		2·09d.
Total working expenditure		7·10d.

The parcels department was operated at a total cost of £17,367 and resulted in a loss of £5,771 for the year.

The gross profit on the year's working amounted to £230,146, to which was added £2,352 interest accumulated, &c., making £232,498, an amount which was disposed of as under:—

Profit Statement, 1906.

Interest, &c.	£49,132
Sinking fund	38,595
Rental of tramways, leaseholds, &c.	18,181
Income-tax	6,418
Surplus	120,172
Gross profit and amounts added as above ...	£232,498

The surplus balance of £120,172 compares with £120,950 in 1905. It was disposed of as follows:—

Renewals and depreciation fund	£70,052 =	1·15d. per c.-m.
Contribution to rates	£46,000 =	·75d. „
Street improvements, interest, &c.	£4,090 =	·07d. „

The renewals and depreciation account stood at £249,212 on March 31st, 1906, after making deductions for renewals and deficit on parcels department.

The general manager is Mr. J. M. McElroy.

ELECTRICITY SUPPLY ACCOUNTS.

Manchester Municipal Electricity Supply.

In a recent issue we gave a lengthy abstract of the working of the Electrical Department for the past year; the principal results during that period are tabulated herewith. The department's three generating stations turned out over 55 million units, being an increase of 16 per cent. on the previous year. A substantial improvement in revenue occurred, which, coupled with a saving in working expenditure, left the department with a gross profit some £35,000 in excess of that for 1905; the allocation of the profit was as shown below. The department carries forward a reserve balance of £34,836, and a renewals balance of £74,590. A gratifying feature of the year was the increased power demands of several prominent firms, estimated at from 7 to 8 million units per annum, and this in conjunction with improved generating conditions due to the use of larger units, augurs well for future prospects.

The generation costs per unit generated for the respective stations were as follows:—

	Dickinson Street.	Bloom Street.	Stuart Street.
Coal	·234d.	·168d.	·158d.
Oil, waste, water and engine room stores	·043d.	·022d.	·025d.
Repairs and maintenance ...	·101d.	·047d.	·041d.
Wages and salaries	·133d.	·072d.	·045d.
	·511d.	·309d.	·269d.

Distribution costs (all stations):—Wages and salaries, ·064d.; repairs, maintenance, sundries, &c., ·063d. = ·127d. per unit.

The maximum loads were:—

	Dickinson Street.	Bloom Street.	Stuart Street.
Lighting load	5,683 kw.	5,515 kw.	3,800 kw.
Traction load	1,500 kw.	2,597 kw.	5,780 kw.
Combined simultaneous load	5,683 kw.	7,370 kw.	9,580 kw.

The prices charged are:—Private lighting, 4¼d. and 1⅞d. per unit; power, 1⅞d. to 1d.; traction, 1½d. approx.; public arcs, 2d. per unit. The chief engineer is Mr. S. L. Pearce.

General Statement.

For year ending March 31st ...	1906.	1905.
Total capital expended	£2,267,127	£2,199,689
Number of units sold—		
Private supply	18,255,313	14,679,373
Public lighting	94,613	81,032
Traction	22,267,858	18,926,305
Total number of units sold ...	40,617,784	33,686,710
Equiv. No. of 8-c.p. lamps connected (pr. ltg.)	565,208	458,442
H.P. of motors connected	12,110	9,395
Number of public lamps	53	53
Maximum load in kw.	21,928	20,023
Revenue account—		
Gross revenue	£329,199	£302,200
„ expenditure	£141,117	*£149,320
„ profit	£188,082	£152,880
Average inclusive price obtained per unit—		
Private supply	2·60d.	2·99d.
Public lighting	1·25d.	2·00d.
Traction	1·38d.	1·50d.

* Includes £13,328 special renewals expenditure.

Revenue Account for Year ending March 31st, 1906.

Gross revenue...	£329,199 = 1·95d. per unit.
Works and distribution costs	£106,761 = 0·63d. „
Total working costs	£141,117 = 0·83d. „

Profit Statement for Year Ending March 31st, 1906.

Interest on loans, &c.	£65,333
Sinking fund and loan instalment	66,543
Renewals account	40,000
Reserve account	16,206
Gross profit	£188,082

CITY NOTES.

Baker Street & Waterloo Railway Co.

The half-yearly meeting of this company was held on Wednesday, at Hamilton House, Victoria Embankment, Mr. T. J. Hare presiding.

In proposing the adoption of the report (Electrical Review, August 10th, 1906, page 229), the Chairman said that the capital expenditure had amounted to £328,533. The contractors, the Underground Electric Railways Co. of London, had completed the line from the Elephant and Castle to Baker Street, together with the carriage depôt and workshops at St. George's Circus. The whole of the rolling stock had been delivered at their depôt at St. George's Circus. The extension from Baker Street towards Paddington Station was being pushed on with as rapidily as possible, and they hoped it would be completed and open for traffic as far as Edgware Road by the end of the year. The line was opened for public traffic between Kennington Road Station, which would in future be called Westminster Bridge Road Station, and Baker Street, on March 10th, the whole distance being just over three miles. During the period under review they had carried 3,006,276 passengers, of whom 430,283 were workmen who paid 1d. for the single and 2d. for the return journey. The average receipts per passenger worked out at 1·85d., being the same as that of the Central London Railway. During the 16 weeks the line had been open, the gross receipts from all sources amounted to £23,490, of which £23,246 was derived from passengers and £244 from transfer fees and miscellaneous receipts. It should be noted that there was no revenue derived from advertisements during the period covered by the accounts, but the spaces throughout the line had been let to Messrs. Wyman, and the receipts from that source should be considerable during the present half-year. Turning to the expenditure, the total working expenses had amounted to £16,681, exclusive of maintenance of way, works and station, repairs and renewals of rolling stock and general charges, which items were payable by the Underground Electric Railways Co. The power expenses had amounted to £5,788 and the traffic expenses to £9,190, of which £6,588 was for salaries and wages. Passenger duty cost them £107. That was a tax that fell particularly heavily on tube railways, where the fares charged were so low, and where they were in competition with motor-omnibuses, which were not subject to passenger duty, and he thought that Parliament might be fairly asked to remit it. There was no doubt that the motor-'buses were serious competitors for short-distance traffic, but whether they could live on the present low fares they were charging was, he thought, doubtful, and he believed that, in the long run, the public would find that they could travel more comfortably, more quickly, and more safely by tube railways. Rates and taxes amounted to £1,572. The board had given close attention to the rating of the company's property, with a view to keeping it as far as possible, within reasonable points. Compensation amounted to only £23. The balance carried to the revenue account was £6,809, and to that must be added £954 for interest and £540 for rents, making altogether £8,084. After deducting £835 to meet rents payable by the company a balance remained of £7,249, or £932 short of the amount required to pay the debenture interest. That deficit had, under the construction contracts, been paid by the Underground Co. Interest at the rate of 3 per cent. per annum on the share capital was payable by the Underground Co. while the line was in course of construction, and warrants for that interest for the past half-year had been issued. When the line was in full working order they confidently expected that the receipts would increase very considerably.

Sir Algernon West seconded the motion, and the report was carried.

Metropolitan District Railway Co.

The directors' report for the half-year ended June 30th, 1906, states that the expenditure on capital account during the half-year has been £151,912. The gross receipts in revenue account amount to £221,055, being an increase of £14,453. The working expenses amount to £166,912, an increase of £52,033. After providing for rent charges, interest on debenture stock, and other charges, the net revenue account shows a deficit of £39,984. This deficiency, together with the sum of £9,375, being dividend at the rate of £1 10s. per cent. per annum on the 4 per cent. guaranteed stock, will be charged to capital account under the company's statutory powers. The number of passengers carried (including estimated journeys by season-ticket holders) has been 32,759,662, being an increase of 5,090,587, or 18·40 per cent. on the corresponding half-year of 1905. The number of passengers carried at workmen's fares has been 8,663,154, being an increase of 1,579,104, or 22·29 per cent., but the District Co.'s share of the receipts (after deducting other companies' proportions in respect of through traffic) has only been ·65d. per passenger. The company incur substantial loss in the carriage of this traffic. The frequent service of trains now being run has involved an increase in the train mileage from 815,667 miles to 1,199,569 miles, or 47 per cent. The increase in working expenditure is exhibited in the following table, arranged under appropriate heads:—

	Half-year June, 1905.	Half-year June, 1906.	Increase.
Maintenance of way and works ..	£11,127	£24,135	£13,008
Maintenance of rolling stock ..	12,835	23,644	10,809
Train working and traffic expenses, after deducting the balance of accounts for work done for and by other companies	52,637	81,245	28,608
Rates and taxes	19,226	20,000	774
Other items	19,055	17,888	– 1,167
Total	£114,880	£166,912	£52,032 = 45·29 %
Train miles on District Railway ..	815,667	1,199,569	383,902 = 47·07 %

The directors have devoted much time and attention during the half-year to the question of fares. Reductions were made from time to time since the year 1900 in many fares, but subsequent experience has shown that these reductions were too great and too numerous. The directors have come to the conclusion that the company cannot reasonably be expected to work the railway with so full and frequent a service of trains as is now being provided, on the basis of existing fares, and that a revision is necessary. Steps are, therefore, being taken to bring a revised scale of fares into operation at an early date. The large increase in working expenditure has been due to more ample provision for the maintenance of the railway and rolling stock, and the running of a more frequent service of trains. Although more time is required for the realisation of the full effect on the traffic of the large number of trains now being run, the results obtained during the past half-year so far as the volume of traffic is concerned are very encouraging. The directors have every reason to believe that when some economies in working, now under consideration, have been effected, and the proposed revision of fares has been brought into operation, the net revenue of the undertaking will show a substantial

improvement. The directors regret that a considerable amount of public inconvenience was experienced in the early part of the half-year owing to frequent failures and stoppages whilst the new train services and the automatic signalling system were being introduced, but they are glad to say that the difficulties have now been practically overcome, and it is believed that the trains will in future continue to be worked with as much regularity as has been recently secured. The steam locomotives and old carriages have been withdrawn from the working stock, and will be realised to best advantage either by sale or otherwise. The Baker Street and Waterloo Railway was opened for traffic on March 10th last, and the interchange facilities between that railway and the District Railway at Charing Cross have created a very convenient route for passengers between District stations and all stations on the Baker Street Railway between Elephant and Castle and Baker Street, as well as stations on the St. John's Wood extension of the Metropolitan Railway beyond Baker Street, and on the City and South London Railway beyond Elephant and Castle. Arrangements have been made to issue tickets at through fares between stations on the District Railway and the Baker Street Railway, and these will shortly be put in operation.

The half-yearly meeting was to be held yesterday.

Yorkshire Electric Power Co.

THE directors' report, to be submitted to the seventh half-yearly meeting, to be held at the Hotel Metropole, Leeds, on Tuesday, September 25th, reads as follows:—"The directors are glad to state that, though the progress of the company has not been so rapid as they had anticipated, it has been steady and continuous. New consumers are being connected, and further negotiations are in progress for supplying large amounts of power. At the end of June consumers were on the mains whose total horse-power was about 1,880. Further agreements now made will, when the consumers are connected to the company's mains, bring the total requirements to approximately 2,450 H.P. The plant installed at the Thornhill generating station is capable, after allowing for ample spare and reserve, of supplying energy to about 10,000 H.P., so that there is still a large surplus available for dealing with future consumers. The revenue from the sale of energy has during the half-year been sufficient to meet practically all the costs of generation of energy at the Thornhill station, and of its distribution throughout that portion of the area in which mains are now laid; it has not yet, however, been sufficient to cover the expenses incidental to developing and managing the company's business. In order to facilitate the work of the staff, it has been decided to remove the central offices of the company to Thornhill. Considerable advantages are anticipated from this concentration."

Liverpool Overhead Railway Co.

THE half-yearly meeting was held at Liverpool on August 14th, Sir Wm. Forwood presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, August 10th), said when they met last February they had to report a decrease in the earnings of the railway, consequent upon the serious competition of the new electrical service inaugurated by the Lancashire and Yorkshire Railway between Southport and Liverpool, and the competition of the Corporation tramways. This competition continued, and he was sorry to say that their traffic, compared with the same half of last year, again showed a decrease. In the first half of 1905 they carried 5,558,000 passengers, and in the first half of this year 5,445,000, a decrease of 113,000 passengers. They also told the shareholders the steps they had taken to counteract this competition by the introduction of differential fares, and long 1d. stages, but these changes had not then been in operation sufficiently long to enable them to form an opinion as to their effect. They had now, he regretted to say, found that the introduction of cheap 1d. fares, so frequently urged upon them, had proved disappointing. The adoption of 1d. stages between every two stations failed to attract sufficient additional passengers to justify the reduction in the value per passenger. Their receipts fell from 1·78d. to 1·71d. per passenger. These long 1d. stages were withdrawn in March, and the 1d. stages were limited to one station only, the result being that the value per passenger increased to 1·75d. They had endeavoured to limit the issue of workmen's return tickets to working men, by restricting the hours of issuing these tickets to 8.30 a.m., instead of 9 o'clock, with the result that the value they received per passenger had further increased to 1·83d. The effect of their trial of 1d. stages was shown, perhaps, more clearly in their earnings per train-mile, which fell to 20·09d., as against 22·50d. in the same half of last year. This figure compared with 33·56d. on the City and South London, 66·60d. on the Central London, and 25·35d. on the Mersey Railway, all electrical undertakings. The directors were forced to the conclusion that the traffic at their command was only a limited one, and could not be increased by reductions in fares, which were already very low. It was a dock side traffic, and comparatively few persons travelled by the line between the Dingle and Seaforth, who had not business in connection with the docks. For a time they very successfully augmented this traffic by an extension by means of their tramways to Waterloo and Crosby, but they had now lost a large share of this suburban traffic by the electrification of the Southport line. They would have to look for a return of prosperity to an increasing dock traffic, and to a development of through traffic to Formby, Southport and Aintree, which they had opened up in connection with the Lancashire and Yorkshire Railway, and also to a lessening of expenses. The latter had engaged the constant attention of the directors. Of course, their line was very short, only 6½ miles; it was worked electrically, and with automatic signalling, the staff was therefore very small, and the room for reduction in expenses very limited, and they must with a quick service of trains carefully maintain the efficiency of the railway in every department. As he informed them at the last meeting, the directors called in Mr. T. C. Jenkin, the manager of the City and South London Railway, to go through all items of expenditure, and to advise if he could suggest any means by which they could effect economies in working. He reported that, on the whole, the traffic was economically worked. He recommended the closing of four stations—Langton, Nelson, Princes and Wapping. After careful consideration, they decided to close entirely Langton and Clarence stations, and to close after 6 p.m. Toxteth, Wapping, Custom House, Princes and Huskisson Dock stations. This came into force on March 1st last. Owing, however, to a strong representation from the Dock Board and the public that the closing of the Clarence station was against the interests of the port, this station was reopened in April. This partial closing of some stations had resulted in considerable economy in working expenses as compared with the period immediately preceding this alteration, but the full benefit of this policy was not shown in the present figures. He trusted he had made it abundantly clear that the directors were fully alive to the situation which had been forced upon them, and which no one could have foreseen, and they were leaving no stone unturned to retrieve the fortunes of the company. They would notice from the report that the number of passengers carried on the railway, excluding the trams, had decreased by 87,936, representing a loss of £2,218 in revenue. The working expenses for the past half-year showed a decrease of £1,348, but as they had carried £500 less to renewal fund, the real decrease was £848. The train-mileage run was 383,000, an increase of 18,890 miles. The total expenditure per train-mile was 16·28d., as against 18·04d., or if the contingent fund was eliminated, the expenditure was only 15·66d., and although they worked and maintained more stations, this compared favourably with other electrical railway undertakings. The expenditure on the City and South London was 15·08d., on the Central London, 34·75d., and on the Mersey Railway 20·22d. The line and electrical equipment had been well maintained. They suffered in revenue by the closing in of the railway by the erection of dock sheds, which destroyed the view of the docks to strangers; also from the increased size of steamers, the greater concentration of work arising from the amalgamation of shipping lines, and the system of sending goods to the interior from the ship's side. All these things tended to reduce the number of men employed about the docks. In conclusion, he assured them that the directors were striving their utmost to bring about better results.

Sir EDWARD LAWRENCE seconded the adoption of the report.

In reply to criticisms from shareholders, the Chairman said that at no time had the railway been worked more economically than it was to-day. The closing and partial closing of some of their stations had been criticised, but by this step they were saving £3,500 a year, and had occasioned the minimum of inconvenience. As to the directors' "fat fees," they had given more labour to the affairs of the Overhead Railway than the directors of the Lancashire and Yorkshire Railway had given to theirs, and he would object to their fees being forfeited. The worst board they could have would be one that offered to do the work without fees. They were all quite willing to resign—let that be quite understood—and the shareholders could at once appoint a new board if they wished, but as long as they continued directors they would faithfully carry out their duties and try to do their best for the company.

The report was then unanimously adopted; as was also a motion to pay the 5 per cent. dividend to preference shareholders.

Mr. G. D. KILLEY, in moving a vote of thanks to the chairman, deprecated the idea of a board without fees, and said it would be a fatality to the company if they lost the services of the present directors.

The resolution was carried with acclamation.

Mexico Electric Tramways, Ltd.—The receipts for the month of July amounted to $381,000, and the working expenses totalled $186,500.

Tramway Meetings.—The half-yearly meetings of the Chatham and District Light Railways Co., Ltd., and the Lanarkshire Tramways Co., Ltd., were held on Wednesday, at 83, Cannon Street, E.C.

Charing Cross, Euston and Hampstead Railway Co.—The statement issued by the directors for the half-year ended June 30th, states that the amount expended on capital account during the period was £436,402, making a total of £4,370,879. It is estimated that the current half-year's outlay will be £600,000, and in subsequent half-years £797,121. The meeting was held on Tuesday, but it was not open to the Press.

National Boiler and General Insurance Co., Ltd.—The report for the past year shows a profit of £18,313, and with the balance brought forward from the previous year there was an available total of £25,896. The dividend and bonus together amount to a total distribution of 20 per cent for the year.

Stock Exchange Notice.—The Committee has appointed a special settling day as under:—

Wednesday, August 29th.—British Aluminium Co., Ltd.—20,000 conversion shares of £10 each, £1 paid, Nos. 1 to 20,000.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open. *
Aberdeen	Aug. 8	3,132	— 112	10	15,357	— 273	14·4 ..
Ayr	,, 8	950	+ 24	12	4,842	— 54	8 ..
Bath	,, 10	2,501	+ 637	32	25,657	+ 4,268	13 ..
Belfast	,, 12	7,461	+2,924	32	103,803	+29,740	40 + 6½
Birkenhead	,, 8	2,354	+ 143	19	20,774	+ 266	13·5 ..
†Blackburn	,, 9	1,178	+ 154	19½	21,010	+ 1,385	13·5 ..
Blackpool Corp. ..	,, 11	5,606	+ 904	19	25,427	+ 1,804	11·67 ..
,, —Fleetw'd	,, 2	4,147	+ 785	6	8,653	+ 1,127	8·25 ..
† ,, —Lytham	,, 12	825	+ 155	89	12,897	+ 1,353	7½ ..
Bolton	,, 8	4,382	+ 330	19	41,762	+ 2,682	26 + 1
Bournemouth	,, 11	4,584	+ 740	18½	32,176	+ 6,854	18·75 + 6½
Bradford	,, 12	10,318	+ 737	19	90,188	+ 3,965	53 ..
Brighton	,, 10	3,513	+ 58	19	20,588	..	9·5 ..
Bristol		12,465	+ 564	..	..	..	28·5 ..
Brit. Elec. Trac. Co							
Airdrie	Aug. 3	403	+ 42	31	6,764	+ 647	3·65 ..
Barnsley	,, 3	331	+ 17	,,	4,969	+ 47	.. ..
Barrow	,, 3	666	+ 85	,,	7,653	+ 422	5·37 ..
Cavehill	,, 3	268	+ 175	,,	2,701	+ 1,031	.. ..
Devonport	,, 3	1,029	+ 33	,,	13,835	— 375	8·85 ..
Gateshead	,, 3	2,076	+ 116	,,	29,724	+ 1,691	11·25 ..
Gravesend, N'fleet	,, 3	560	+ 1	,,	7,236	+ 270	6·5 ..
Greenock	,, 3	1,539	+ 124	,,	20,297	+ 792	7·25 ..
Hartlepool	,, 3	776	+ 161	,,	9,041	+ 1,090	6·72 ..
Kidderminster ..	,, 3	291	— 6	,,	3,586	— 60	.. ..
Leamington	,, 3	419	— 22	,,	5,404	+ 2,833	3 ..
Merthyr	,, 3	413	+ 36	,,	5,971	+ 83	2·9 ..
‡Metropolitan ..	,, 3	7,539	+ 636	,,	103,177	+26,275	22 ..
Middleton	,, 3	824	+ 54	,,	10,809	+ 293	8·5 ..
Mid. Joint Com'tee	,, 3	20,295	— 553	,,	314,419	+18,233	.. ..
Oldham — Ashton	,, 3	1,225	+ 50	,,	17,346	+ 531	9·13 ..
Peterborough ..	,, 3	320	— 1	,,	3,857	— 322	5·31 ..
Potteries	,, 3	3,675	+ 203	,,	54,643	+ 2,754	29 ..
Rothesay	,, 3	1,153	— 128	,,	6,527	+ 951	2·75 ..
Southport	,, 3	818	+ 95	,,	9,562	+ 206	8·17 ..
Swansea	,, 3	1,896	+ 125	,,	24,853	+ 4,509	5·5 ..
Tynemouth	,, 1	879	+ 50	,,	7,706	— 206	3·75 ..
Weston-s-Mare ..	,, 3	676	— 3	,,	3,716	+ 122	3 ..
‡Worcester	,, 3	690	— 15	,,	8,507	— 723	5·75 ..
Wrexham	,, 3	222	+ 3	,,	3,087	— 9	.. ..
Yorks. Wool. Dist.	,, 3	2,138	+ 612	,,	27,684	+ 8,073	17 ..
Miscellaneous ..	,, 3	249	— 68	,,	3,096	— 517	.. ..
Burnley	,, 11	2,616	+ 261	31	..	..	7·5 ..
Burton-on-Trent ..	,, 12	738	— 16	19	5,998	— 886	9·5 + 1
Bury	,, 5	2,081	..	18	12,364	..	10·5 ..
Cardiff	,, 4	4,525	+ 83	18	38,059	— 1,086	15·87 ..
Carlisle	,, 11	456	+ 13	32	5,878	— 50	.. ..
Chatham and Dist.	,, 9	1,703	— 44	32	20,747	— 475	10·29 + ·96
Colchester	Mar. 7	327	— 5	31	5,660	..	7½ + ½
Cork	Aug. 9	1,183	+ 47	32	15,239	— 347	9·89 .. ·5
Croydon	,, 10	3,587	+ 207	10	16,832	+ 1,144	11·25 + ·5
Darlington	July 28	450	+ 1	17	3,652	..	4·67 ..
Darwen	Aug. 10	535	+ 61	19	4,878	+ 175	4·36 ..
Dover	,, 11	776	+ 140	19	5,273	+ 750	4·75 + 1½
Dublin	,, 10	12,266	+ 850	6	33,677	+ 413	18·75 + ·25
Dundee	,, 8	2,307	+ 601	12	13,624	+ 2,901	13 + ·5
East Ham	,, 11	2,106	+ 130	19	18,920	+ 1,669	8 + ½
Exeter	,, 10	765	+ 46	19	5,740	— 405	4·25 ..
Glasgow	,, 11	33,592	+3,762	13	173,017	+12,361	81·25 + 5½
†Gloucester ..	Feb. 21	221	+ 12	17	..	..	15 ..
Halifax	July 25	3,386	— 129	..	28,937	+ 1,188	37 + 1·5
Hastings	Aug. 10	2,833	..	19	..	..	.. ..
Huddersfield ..	,, 11	3,306	+ 320	19	29,644	+ 2,873	28 ..
Hull	,, 11	4,958	— 318	19	43,472	+ 799	13 ..
†Ilford	,, 11	686	— 17	19	9,978	+ 70	6·37 ..
Ilkeston	,, 8	348	+ 95	19	2,607	+ 196	3·5 ..
Ipswich	,, 11	1,240	+ 4	19	8,875	— 203	10·5 ..
Isle of Thanet ..	,, 11	3,691	+ 252	32	1,557	— 570	11 ..
Kilmarnock	,, 11	349	+ 6	13	2,169	— 79	4·12 ..
Kirkcaldy	,, 8	468	+ 46	..	..	..	7·5 ..
Lan'kshire Trm. Co.	,, 9	1,754	— 24	32	27,673	+ 5,658	12·56 + ½
Leeds	,, 4	13,226	+1,342	18	115,179	+ 5,728	96 + 6½
Leicester	,, 11	5,218	+ 55	32	70,753	+ 4,398	.. ..
†Leith	,, 4	539	+ 810	11½	6,421	+ 3,460	6 + 1
Liverpool	,, 4	22,751	— 124	31	390,892	+ 5,417	104 + 1
‡L.C.C.	July 28	53,219	..	17	452,647	..	93½ +41½
London United ..	Aug. 10	17,161	+1,574	32	198,463	+11,822	.. ..
Lowestoft	,, 11	870	— 38	46	7,261	— 566	3·5 ..
Manchester	,, 11	29,934	+3,968	19	263,542	+12,741	84 ..
Newcastle	,, 11	8,221	+ 168	19	79,082	+ 5,006	25·5 ..
Newport	,, 4	1,340	+ 72	18	11,507	+ 449	14·5 + 1·5
Northampton ..	,, 10	1,186	+ 8	19	8,926	+ 41	5·5 ..
Oldham	,, 12	3,885	+ 484	20	36,444	+ 3,160	23 ..
Pontypridd	,, 11	393	+ 7	19	3,304	+ 6	3·5 ..
Portsmouth	,, 11	5,988	—1,560	19	41,696	— 1,642	14·5 ..
Preston	,, 8	1,645	+ 289	..	..	..	10 ..
Reading	,, 9	1,588	+ 26	19	12,412	— 35	7·5 ..
Rochdale	,, 11	2,120	+ 353	19	18,344	+ 5,790	20·6 + 1½
Rotherham	,, 9	1,171	+ 184	19	9,563	+ 912	9·33 ..
†Salford	July 30	4,690	+ 236	17	79,169	+ 424	38·9 ..
Sheffield	Aug. 12	11,211	+1,079	20	106,497	+ 6,028	35·75 + 1½
Southampton ..	,, 8	2,467	+ 25	18½	18,872	+ 43	.. ..
Southend-on-Sea ..	July 25	1,045	— 44	17	6,708	+ 112	6 ..
†Stalyb'dge, Hyde, &c	Apr. 21	807	+ 100	3	2,456	..	21 ..
Stockport	July 21	2,049	+ 49	16	16,021	+ 5,265	15·5 + 4
Sunderland	,, 15	3,154	+ 59	15	21,471	+ 1,109	10·87 ..
Swindon	,, 3	331	— 83	13½	2,642	— 49	4·4 ..
Tyneside	Aug. 8	1,136	+ 202	32	14,578	+ 1,058	8·87 ..
Walthamstow ..	,, 11	1,650	..	19	12,665	..	10 ..
Warrington	Mar. 29	677	+ 43	52	17,804	+ 1,247	6·37 + ·25
West Ham	Aug. 9	5,018	+1,016	19	44,429	+13,256	14·7 + ½
Wolverhampton ..	,, 2	1,964	..	..	..	..	10 ..
Yorks. W. Riding ..	,, 12	2,230	+ 98	32	26,542	..	.. ..
Baker St.-Waterloo	,, 11	2,500	..	6	7,989	..	3·25 ..
Cen. London Rly. ..	,, 11	10,071	— 807	6	33,441	— 1,480	6 ..
City & S. Lon. Rly.	,, 12	4,538	+ 101	6	14,655	+ 1,162	6·25 ..
Dublin-Lucan Rly.	,, 10	332	+ 7	6	908	— 37	7 ..
G. N. and City Rly.	,, 11	2,906	+ 115	6	9,405	+ 772	3·5 ..
L'pool Overh'd Rly.	,, 12	3,368	— 106	6	9,641	— 402	6·75 ..
Mersey Railway ..	,, 11	3,409	+ 283	6	9,876	+ 834	4·5 ..
Metropolitan Rly. ..	,, 12	27,868	..	6	88,399	..	70·5 ..
Met. District Rly. ..	,, 12	15,709	+1,134	6	45,086	+ 5,671	24 ..
Anglo-Argentine ..	June 22	10,276	+4,472	6	472,885	+50,751	43 ..
§Auckland	,,	10,225	+1,319	25	61,419	+ 4,193	18·64 ..
§Brisbane	July	11,158	+ 896	..	..	..	.. ..
§Brit. Columbia Rly.	June	14,761	+3,724	52	186,188	+47,801	.. ..
†Bu'n's A'r's E.T.Co.	July 7	1,163	— 11	27	37,009	+ 6,829	24 ..
Bu'n's A'r's-Blgr'no	Aug. 5	6,740	— 66	31	110,130	+ 6,276	.. ..
Calcutta	,, 11	5,731	— 182	..	..	..	.. ..
§Cape Electric T. Ld.	May	14,806	..	..	..	..	.. ..
§Geneva	June	7,905	..	..	..	..	.. ..
Perth (W.A.) ..	Aug. 10	2,739	+ 295	32	47,290	+ 2,883	24·25 + 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

From its atmosphere of gloom and inanition in prices, the Stock Exchange has suddenly emerged into the brilliant sunshine of strength and activity. Precisely what has brought about this swift transition, this is scarcely the place to examine, but amongst the various bullish points that outstand, the less unsettled political outlook, the trade prosperity of the country, and the easing of the money market, deserve prominent mention. Home Railway stocks of all kinds except electrical are exceedingly good, and prices rise by points instead of falling by fractions—all of which is so unusual that the financial scribe feels a certain disappointment at the lack of response to the general brightness which is exhibited in the various electrical departments of stock and shares.

However, the better tone amongst Supply varieties is still in evidence, but so, unfortunately, is the failure of quotations to materially improve. Edmundson's Ordinary are down again to 3½, and Westminsters—consistent in their weekly lack of strength—have lost 5s. London Electric Ordinary declined ½, and so did Oxfords, the last being 6½. Writing of Edmundson's, it seems singular that the company's 4½ per cent. Debenture stock should be quoted as low as 101½. From all we can ascertain, the stock is abundantly secured, and though the results of the operations in Ramsgate, Scarborough and one or two other places may not be satisfactory, the company is doing fairly well elsewhere. The Ordinary shares, perhaps, partake of a speculative character, but the Debenture stock appears to be a good enough investment.

Rises there are in other Supply shares, balancing the losses just mentioned. Charing Cross, City Preferences are better at 4½, City Ordinary are ¼ up at 7½, and so are Urban Preference at 4½. Prior-charge stocks show a hesitating disposition to harden. Brush Electrical Ordinary at 17s. 6d. are ⅛ better, a fraction by which Electric Constructions at 7s. 6d. are lower.

Before very long, we shall have to quote London and North-Western Railway stock amongst others of the metropolitan electrical list, for Lord Stalbridge has announced that the company has in contemplation an electrified line from Euston to Watford. There has been another smart drop in Districts this week upon the issue of what can only be called a disastrous report. The price is no better than 22. Metropolitan Consolidated at 66½ reflects the cheerful tone of the Home Railway market as a whole, and substantial improvement in London and South-Western stocks produced the rise of 2 points in Waterloo and City. An improvement of 2 has taken place in Central London Ordinary, but City and South Londons are unchanged, the open-air competition being severely felt this hot weather.

Traction fluctuations contain advances of ¼ in British Electric Preference, 2 points in the company's First Debenture, and 1 point in its Second Debenture stocks. Buenos Ayres and Belgrano Ordinary and "B" Preference advanced $\frac{5}{16}$ and ⅛ respectively upon the issue of the half-yearly statement, whereas Dublin Ordinary, falling ¼, came to the same price as the Preference, viz., 14½. There is not much business doing in this department.

More trade passes in Telegraph and Telephone issues. Anglo-American Telegraph stocks are decidedly better, the Deferred escaping from the attentions of the short interest and bounding up to 22⅝ again. It is pleasant to be able to notice improvements of 2 in Eastern Telegraph stock, and of 5s. in Eastern Extension shares, although Eastern Debenture is ½ lower. This is out of harmony with the sentiment for other debenture stocks in the market, which are being taken by investors at rising values. Amazon Debentures at 89½ are better by a brace of points—the phrase follows appropriately upon August 12th. The different Trust descriptions have not changed.

National Telephone stocks are good, the Preferred at 108½ and the first and second Preferences at 12 and 11½ being all 10s. better. The third Preference at 5⅝ marks the recovery of its slight relapse last week.

Several manufacturing shares have received more support, and British Insulated added another 5s. rise to their earlier improvement. The price has now reached 7. Henley's Preference at 5½ are firmer, but Willans & Robinson have relapsed to no more than a sovereign. British Westinghouse Preference shares received no benefit from the distribution of the chairman's photograph by a financial daily paper last Saturday—in fact, the price is flat at 30s. Babcock & Wilcox at 4 are firmer.

Hadfield's Steel Foundry Co.—The *Financial Times* says that the directors will pay an interim dividend of 1s. each on the ordinary shares for the half-year ended June 30th.

Oldham, Ashton and Hyde Electric Tramway Co.—An interim dividend at the rate of 5 per cent. per annum is recommended.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Aug 7th.	Closing Quotations Aug. 14th.	Business done week ended Aug 14th, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3½ — 4	3½ — 4	..	..	..
155,600‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	85 — 90	87 — 92	..	..	+2
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	111 —112 xd	113½—114½ xd	114⅜	112	+2½
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6¼%	6 %	21⅜ — 21⅝	22⅛ — 22⅜	22⅛	21⅛	+1⅛
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛%	101 —103	101 —103	..	..	..
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	7⅞ — 7¾xd	7⅞ — 7¾	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	97½ — 99½	97½ — 99½	98½	97½	..
1,932,855‡	Commercial Cable Stng. 500 year 4 % Deb. Str. Red.	Stock	4 %	4 %	4 %	4 %	8½ — 9	8½ — 9	8½	..	..
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %	17 — 18	17 — 18	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	38 — 38	38 — 38	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8¾ — 9¼	8¾ — 9¼	9¼	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	98 —101	98 —101	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	15½ — 16	15½ — 16	15⅝	15⅜	..
60,710‡	Direct United States Cable	20	8½%	8 %	8½%	4½%	99½—101½	100 —102	..	..	+ ⅛
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	142 —145	144 —147	146	142½	+2
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	89½ — 91½	89⅝ — 91½	91½	89½	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	107 —109	106¾—108¾	108	107½	— ⅜
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	14 — 14½	14⅛ — 14⅝	14⅜	14⅛	+ ⅛
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	105 —107 xd	105 —107 xd	106½	..	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101 xd	99 —101 xd	..	..	..
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£8	5½%	5⅝%	5½%	10⅜ — 11 xd	10⅜ — 11 xd.	10⅛	10⅜	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14½ — 14⅝xd	14⅜ — 14⅝ xd	14⅛	14⅛	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	38 — 40	38 — 40	39½	38⅜	..
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99½—101½	100 —102	..	..	+ ½
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	58 — 60	58 — 60	55½	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	1 — 1 1/16	1 1/16 — 1 1/8	..	..	+ 1/16
86,429	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1 — 1 1/16	1 — 1 1/16	..	..	— 1/16
1,988,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —109	107½—109½	108½	107⅝	+ ⅛
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	107 —109	107 —109	108	107⅛	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10½ — 11¼xd	11 — 13	11 5/16	11 1/16	+1
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12 xd	10½ — 12½ xd	..	..	+ ⅛
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16 — 5 1/8	5⅛ — 5⅜ xd	5⅜	..	+ 1/16
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	9½%	8½%	8½%	8½%	97 — 99	97 — 99	98⅜	..	..
1,689,599	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	103½	102⅜	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¾%	6¾%	7⅜%	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/16	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839‡	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7¾	7½ — 7¾	7⅞	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	129 —132	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛	7⅞	7 3/32	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..
15,609‡	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅛ — 10	9¼ — 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	2 — 2 1/8	2 — 2 1/8	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½—103½	100½ — 103½	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 14⅝	14½ — 14⅝	14⅛	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. — ..	.. — ..	..	..	..
568,880	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	105½	104½	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1/16 — 1/16	3/32 — ½	9/6	8/9	—1/16
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6½ — 6⅝	6½ — 6⅝	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½ — 5¼	4½ — 5⅜	..	..	..
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

140,000	Anglo-Argentine Trams, 400,008 to 440,007 ..	5	..	..	6 %	6 %	6½ — 7 1/16	6½ — 7 1/16	7	6⅞	..
100,000	Do. Nos. 430,008 to 910,007 and 560,008 to 580,007 ..	5	..	..	..	..	6½ — 6⅝	6½ — 6⅝	6⅝	6 1/16	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	6½ — 6⅝	5½ — 6	5⅝	5⅜	— ⅜
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	102 —104	102 —104	103½	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	20 %	3⅜ — 4	3⅜ — 4⅛	80/-	79/9	+ ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3⅜ — 4	3⅜ — 4	76/10½	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6½	6 — 6½	6½	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5 — 5½	5 — 5½	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4½	4 — 4½	82/6	..	..
300,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	102½	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	117 —120	117 —120	118⅝	118½	..
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	105 —108	105 —108	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105	103 —105	103½	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5¼ — 5⅜	5¼ — 5⅜	5⅜	..	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	8⅝ — 9¼	9 — 9½	9½	9	+ ⅛
1,415,422‡	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	109 —112	111 —114	114½	110	+2
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	89 — 92	90 — 93	..	..	+1
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾ — 7	6⅞ — 7⅛	6⅞	6 1/8	+ ⅛
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6 xd	5⅝ — 6	6	5⅝	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	83 — 88	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1½ — 2	1½ — 1⅞	..	..	— ⅛
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 83	77 — 83	78	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	7/6 — 11/-	7/6 — 11/-	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	3/4 — 1	3/4 — 1	..	..	+ ⅛
150,000	Do. Non-cum. 6 % Pref... ..	2	6 %	6 %	6 %	6 %	1½ — 1⅝	1½ — 1⅝	..	..	..
125,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	83½	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3¼ — 3⅜	3 1/16 — 3 1/8	75/-	67/9	+ ⅜
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	5 1/16	5⅛	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅝ — 5⅜	5 — 6½	..	..	+ ⅛
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106	104 —106	105	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —106	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8 — 8⅜	8 — 8⅜	8⅛	..	..
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7⅞ — 8⅜	7⅞ — 8⅜	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	105¾	104	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10⅛ — 11⅛	10⅛ — 11⅛	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
900,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	1/16 — 1/8	1/16 — 1/8	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	21/6	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100 xd	95 —100	..	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	87 — 89	88	85½	+2
530,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	100½	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	76	74½	..
480,000	City and South London Railway	Stock	3½%	2¾%	2½%	1¾%	45 — 47	45 — 47	47	46	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	2½%	1½ — 2	1½ — 2	..	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Aug. 7th.	Closing Quotations Aug. 14th.	Business done week ended Aug. 14th, 1906. Highest	Lowest	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	† 1	..	..	10 %	..	1 11/16 — 1 13/16	1 11/16 — 1 13/16	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 1/4 — 1 3/8	1 1/4 — 1 3/8	24/6	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	14¼ — 15¼	14 — 15	..	..	— ¼
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	96 — 98	98¼ — 99	..	..	+1⅜
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 — 97	96⅜ — 96	..	..	+ ⅜
99,361	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,361	5	Nil	Nil	2½%	..	1¼ — 1⅜	1⅛ — 1⅜	..	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½%	..	2¼ — 3	2¼ — 3	..	..	..
344,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	⅜ — ½	⅜ — ½	6/6	6/3	— ⅛
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	7 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	86 — 89	86 — 89	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9⅜	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3¼ — 3⅝	3⅛ — 3⅜	73/9	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10 — 11	10⅛ — 10⅝	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	101 —103	..	..	+ ½
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	..	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅜ — 5⅝	5 3/32	5⅛	+ ⅛
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	108½	..	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107 —109	107 —109	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅞	17½	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	18%	1½%	Nil	1¼ — 1⅜	1 — 1⅛	..	..	— ¼
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4⅜ — 6⅛	4⅛ — 6⅜	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8¼	8 — 8⅜	..	..	..
899,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	4 — 5	3⅞ — 4⅛	..	..	— ⅛
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8¼ — 8⅝	8⅛ — 8⅝	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	93¼ — 96½	93⅛ — 96½	93½	..	..
814,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	2/6	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	17/-	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	97/6	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6⅞ — 7⅜	6⅞ — 7⅜	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	33 — 35	33 — 35	34⅜	33½	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	102 —105	..	..	+2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	3 %	Nil	Nil	1 — 1½	⅞ — 1⅛	..	..	— ½
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2⅜ — 3½	2⅞ — 3½	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞ — 8⅛	7⅞ — 8	8⅛	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	101 —104	..	..	+1
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	91/3	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅞	92/6	91/3	+ ⅛
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	4 — 4⅛	82/6	..	+ ⅛
40,000	Do. do. 1908	5	..	4½%	4½%	4½%	3⅞ — 4⅛	4 — 4⅛	80/-	..	+ ⅛
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	101	100½	..
44,486	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	5⅜	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	107½	106½	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10 — 10⅜	10 — 10⅜	10⅛	10	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 12⅛	11⅛ — 12⅛	12⅛	12 1/16	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 1/16 — 3 1/16	2 1/16 — 3 1/16	..	..	..
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	7⅞ — 8⅛	8 — 9	8⅜	8⅛	+ ⅛
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	12 1/16	11⅛	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	107 —110	109½	..	+1
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3⅜ — 3⅝	3⅛ — 3⅜	68/9	..	— ⅛
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅜ — 5⅛	5	..	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101½	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 18,000	5	..	8½%	8½%	9 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6¾ — 7	6⅞ — 6¾	..	..	— ⅛
37,303	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	13%	12 %	10 %	9⅞ — 10⅜	9⅞ — 10⅜	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2⅛	1⅞ — 2⅛	38/9	..	— ⅛
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	5 3/32	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8 — 9	8 — 9	8⅛	8⅛	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5¼ — 5⅜	5¼ — 5⅜	5 13/16	5 3/16	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	94 — 96	94 — 96	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅜ — 6⅞	6⅛ — 6⅜	..	..	— ⅛
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	97 — 99	98 —100	..	..	+1
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10⅛ — 11⅛	10⅛ — 11⅛	..	..	..
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2 — 2½	2 — 2½	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 78	74 — 78	..	..	..
65,000	South London Electricity Supply, Ord.	5	13½%	8 %	4 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅜ — ½	⅜ — ½	..	..	..
85,358	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	Nil	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	23/9	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3⅞ — 4	3⅞ — 4	70/-	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 5	92/6	..	+ ⅛
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	98 —101	..	..	—1⅛
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9⅞ — 10⅜	9⅞ — 10⅜	10⅛	9 13/16	— ⅛
28,151	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5 1/16	..
	(Originally 5 %—Red. to 4½ % from 31st Dec., 1905.										

Shares not officially quoted:—Mackay Companies, ord., 75—77. Pref. 75—77.

† Unless otherwise stated all shares are fully paid.

§ Interim dividends.

(Bank rate of discount 3½ per cent, June 21st, 1906).

ARC LAMP CARBON ENDS.

By VERAX.

Any practical suggestion concerning the utilisation of arc lamp carbon ends should receive favourable consideration from electrical engineers for reasons which are obvious. More than one solution has been mentioned, and the measure of success is not undeserving of notice. The cost of new carbons works out somewhere about ¾d. per ft. — quite a modest figure undoubtedly; but when it is remembered that thousands of feet of this commodity are consumed annually at every lighting installation of average size, it seems unfortunate that there is no market for the unconsumed pieces, which accumulate with surprising rapidity.

An economical method of using up arc lamp carbon ends, instead of consigning them to the cinder tip or mortar mill, was described about nine months ago by L. Bernard in the *Elektrotechnische Zeitschrift*. It consisted in cementing several ends together so as to form a single long carbon. The cementing was carried out by cutting the ends of the pieces so as to allow them to fit together, covering these ends with a paste made of water glass and powdered carbon, and then lightly pressing the pieces together. Such made-up carbons were found to be satisfactory in every way. They burned, both with direct and alternating currents, just as well as new carbons even at the junctions. Tests proved that the resistance was but little greater than that of new carbons, whilst as regards mechanical strength the made-up carbons, when subjected to a uniform stress, were found, if anything, more liable to break between joints than at the joints. In order to verify the researches of the gentleman named, a few simple experiments were conducted at a railway lighting installation in the north of England.

Several broken fragments were collected from the scrap heap and jointed in the manner already described, after which they were left overnight on the boilers to dry and bake.

The statement was confirmed regarding the strength of the jointed parts, and the resistances of two such carbons measured with a Wheatstone bridge are tabulated below; whilst for purposes of comparison the resistances of two perfect ones are also given :—

13 mm. carbon, enclosed	...	*jointed*	= 0·26ω
13 " "	...	"	= 0·33ω
13 " "	...	*not* jointed	= 0·17ω
13 " "	...	"	= 0·18ω

These made-up carbons were consumed without reducing the percentage of light rays which is attainable with perfect ones; neither was there any irregularity in feeding, a steady arc being maintained throughout. It should, however, be borne in mind that these remarks apply to single and twin carbon *enclosed* lamps only. At some lighting plants it is customary, when lamp trimming, to renew the positive carbon and transfer the recovered piece, about 4 or 5 in. long, to the negative holder, because, as is well known, the carbon on the negative side is consumed at a much slower rate. Consequently not more than 2 in. of carbon per lamp is really wasted, and wherever such a practice is in operation it is a moot point which engineers must decide for themselves, whether carbon jointing is or is not desirable.

A similar experiment was made in connection with *open* type arc lamps on a direct-current 220-volt circuit. This pressure admits of four lamps being joined in series across the mains together with a slight resistance, the latter ensuring a normal current of 10 amperes passing through the lamps. Prior to inserting the jointed carbons in the holders, tests were made as before, and the results may be read at a glance :—

18 mm. carbon, open type positive	...	*jointed*	= 0·19ω
18 " " "	...	"	= 0·17ω
18 " " "	...	*not jointed*	= 0·04ω
18 " " "	...	"	= 0·07ω
13 " " negative	...	*jointed*	= 0·18ω
13 " " "	...	"	= 0·23ω
13 " " "	...	*not jointed*	= 0·15ω
13 " " "	...	"	= 0·16ω

If a recording ammeter were inserted in the open arc 10-amp. circuit alluded to above, a momentary rush of current amounting to about 28 amperes would be noticeable on the chart, but within two minutes the consumption would have fallen to the normal figure. Now this excessive current acted disastrously upon the made-up carbons, for as soon as the switch was closed the jointed ends became red hot, then incandescent, and immediately afterwards broke into as many parts as there were jointed sections. Why such carbons proved a success with one class of lamps, and a failure with another type, may be accounted for by the excess of current at the moment of striking-up in the open arc, as compared with the enclosed arc circuit. The conclusion to be drawn from the foregoing tests supplemented by personal observation is this : A jointed carbon will safely carry a steady current of 16 amperes or thereabout, but will collapse when subjected to a greater amount.

Another useful purpose to which scrap carbon ends may be allocated is for lightning conductor work. Owing to the higher conductivity of carbon over that of coke, these broken pieces make an excellent bed for lightning conductors, and whenever the ground is being opened out for earth-plate repairs, this important fact should not be lost sight of. It has been stated on more than one occasion that if an earth plate be sunk in damp earth, it matters not whether the resistance registers one or a thousand ohms. Opinions may differ as to the wisdom of that kind of reasoning, but we are quite certain that if a conductor is intended to render a building perfectly safe from lightning flashes, other things have to be considered besides a damp sub-soil, though that is very important.

Two eminent authorities in the electrical world are agreed upon the importance of a low resistance to earth; thus, Sir Wm. Preece, in his work on "Telegraphy," p. 390, affirms that, "unless the circumstances are very exceptional, the resistance of an earth should not be permitted to exceed 10 ohms." Equally emphatic is Mr. Siemens, who, in his booklet on "The Magneto Inductor and Bridge," declares that "the efficiency of a lightning conductor greatly depends on its electrical resistance being low, and this should not exceed 10 ohms from the apex to the earth connection, inclusive of the resistance of the latter." The relative values of coke and carbon for this class of work may be judged from what is hereafter recounted.

A certain conductor was repaired some time ago, the earth plate being surrounded with coke, after which the usual test was made and balance obtained on the bridge galvanometer at 22 ohms. Shortly afterwards another conductor plate was laid in a similar sub-soil, but carbon ends were freely scattered thereabout; the resistance measured 1 ohm. A third conductor has since undergone renovation, but in addition to tipping two hand-cart loads of scrap carbon around the earth plate, a connection was made from the latter to a water main that was encountered during the process of excavation; the resistance offered was 0·4 ohm.

We understand that on one important railway company large casks are supplied to those stations which are electrically lighted. When, in due course, these casks are filled with old carbon ends, a notification is sent to headquarters advising them of the fact; whereupon instructions are issued to load and consign the casks to any part of the line where earth-plate repairs are being effected. On first thoughts the supply would presumably exceed the demand, and, as a matter of fact, that is so; but it should not be forgotten that railway companies have a much larger number of conductors than are owned by private firms. An observant railway traveller can scarcely fail to notice the numerous chimney stacks, goods warehouses, locomotive sheds, offices, hotels, &c., all of which, owned by the railway company, need protecting by at least one lightning conductor each.

Most companies let this class of work by private contract, whilst a very few engage the services of a thoroughly practical "steeple jack," and provide him with permanent employment. Thus regular attention is given to finials, earth plates and all, the telegraph department periodically testing the same and recording the resistance. Whichever system were adopted, it would be a good plan to insert a clause in the specification enforcing the use of scrap carbon, to be supplied in every case by the railway company.

A suggestion is here made, and may be accepted for what it may be worth—namely, that in view of the trifling cost at which scrap carbon can be purchased, contractors should make a more liberal use of it, for clients would surely not

object to the slight additional expense after receiving an assurance that their lightning conductor would be guaranteed long life, efficiency and reliability.

SYSTEMS.

By R. C. DIEPPE, A.M.I.E.E.

There are a number of writers who are only too ready to write article after article dealing with systems, but the question arises as to whether system is not carried too far in many cases. The writer having been in a number of works of varying size and employing from 12,000 or 14,000 hands to a few dozen, has had the opportunity of seeing a number of different systems in work, and is of the opinion that system is overdone in many cases, this remark generally applying to firms employing, say, 100 or 200 hands (that is to comparatively small works).

A system should undoubtedly be adopted to suit the case of the works under consideration, and not an endeavour made to adopt a certain system to the particular works, irrespective of whether the system is suitable for those works or not. Many readers will undoubtedly know of cases where works are being killed by system, and one most glaring case came under the notice of the writer where this was being done.

This was the case of a concern, where work of a very general character was carried on, there being a large variety of articles manufactured, and the numbers off each design comparatively quite small. The system adopted here for a time was to give every individual piece—such as screws, washers, &c., besides the main castings and other parts—a symbol, consisting in many cases of a string of letters and figures, and all these minute parts were drawn out in detail separate from the general arrangement drawing. The idea being, of course, that the cost of each of these minute articles could be ascertained. Now, although this system might be suitable for works where only a few different articles are made and those in great quantity, it was not suitable for the works in question. In this particular case there would be as many as seven or eight drawings for a comparatively simple article, and irrespective of the question of the cost of all these designs, there is no doubt that time was lost in the shops through there being so many drawings; in fact, the men required so much time to understand the drawings, that increased piecework prices had to be paid. Again, it is a question if it is altogether advisable to give a man a drawing of a part in detail without any intimation of what that part is required for on the complete article, as although a certain size may be given, say, 1 in., on the detail drawing, that size may have to be ·990 in. or 1·005 in. for the article to assemble with the other parts.

Generally a system is used to enable accurate and detailed costs to be kept, but it is very doubtful if it is possible in practice to keep such accurate costs, and in any case an elaborate system means that the foremen and prime cost clerks have a lot of additional work to do; in the case of the former the time might be more profitably employed in supervising the men, while in the case of the clerk a smaller staff could be kept with a less elaborate system.

The writer got out and used a system of quite a simple nature, which was found to work quite smoothly in the shops and offices, and which gave the cost of goods in detail quite sufficiently for all ordinary purposes. A similar system may possibly be in use with other firms, but a description of it may be of interest.

Works of any size whatever are always divided into different shops for the various kinds of work carried out, and in the case of an electrical manufacturing firm, these shops would generally comprise: Engineers' shop, pattern shop, winding shop, brass finishing shop and test room, and the cost books should be divided into sections for each order number to correspond with these shops. Now take the case of a dynamo, the work on this can conveniently be divided into the following sections: Armature, field-magnet system, bearings or end covers, brush gear and rocker, pulley, assembling machine, painting and packing machine. Each of these items is given a sub-number, and the material and labour on these parts are booked to the main order number over the sub-number. For instance, say the main order number is 100, then the labour and material used on the field-magnet system would be booked to the number 100/2, and so on, and it will be seen that not only is it possible to obtain the cost of the complete magnet system, but it is also possible to obtain the cost of winding the coils, &c. Again the letters X, Y and Z were used as sub-letters to denote extra work which had to be done due to errors in the drawing office, shops and faulty material, and this very soon showed up any weak spots in the offices or shops, as, of course, if any time were booked to these sub-letters, the reason had to be explained.

The system is quite simple both in the shops and offices, and generally gives quite detailed enough costs for all ordinary purposes, but if further detailed costs are required, further sub-divisions can be made, although, in the writer's opinion, the sub-divisions indicated above are quite close enough. The same system can be used for practically any kind of work, and what was done in this particular case was that all the work carried out was divided up in the way indicated above, copies of the schedule being placed in the offices and stores, and also given to all the foremen and cost clerks.

Whilst dealing with the question of systems and costs, mention may be made of a point which does not always receive the attention it deserves, and that is the proportion of unbooked time to booked time in any particular shop or office. It is, of course, not possible to book all time in any shop or office to order numbers. For instance, the foreman's time cannot be booked, and there are almost always labourers and others whose time cannot be booked, and it will easily be seen that a particular shop may be turning out work very cheaply on paper, but not quite so cheaply in reality. As a check against this, the writer kept a curve of this percentage of unbooked to booked time for each shop and office, the curves being made up each week. This was found to have a very good effect on the foremen who were aware that the curves were kept, and who had to explain any sudden or gradual rise in their curve. The percentage, of course, varied very considerably with the different shops, some of the shops being as low as 8 per cent. or 9 per cent., whilst one was as high as 20 per cent. to 25 per cent., the latter figure indicating, of course, that something was wrong, which indeed was the case, there being a total lack of lifting appliances, and other general drawbacks.

BUILDERS, BUILDING OWNERS AND THE LAW OF ELECTRIC LIGHTING.

[BY OUR LEGAL CONTRIBUTOR.]

So many legal queries have been addressed to the editors of the Electrical Review within recent months, that it seems fitting to publish an article setting out some of the more important principles of the law relating to electric lighting. To builders and building owners this branch of the law is of great and increasing importance. Few houses in certain districts are now built without being fitted for electric light; and it is all important for persons who are embarking upon a building scheme to know how far those who are to occupy the houses on the estate may secure a supply of electricity.

Preliminary.—There are certain provisions of the various statutes and orders relating to the supply of electricity to which builders and the owners of building estates should direct their attention. Electricity is usually supplied either by the local authority or some private company acting under the authority of a provisional order confirmed by Act of Parliament. Subject to and in accordance with the provisions and restrictions of the Electric Lighting Act, 1882, 45 and 46 Vict. c. 56, and of any rules made by the Board of Trade in pursuance of that Act, and of any license, order or special Act authorising or affecting their undertaking, and

for the purpose of supplying electricity, the undertakers* may acquire such lands by agreement, construct such works, acquire such licences for the use of any patented or protected processes, inventions, machinery, apparatus, methods, materials, or other things, enter into such contracts, and generally do all such acts and things as may be necessary and incidental to such supply. (Electric Lighting Act, 1882, Sec. 10.)

In order to enable the undertakers to carry out the objects of their provisional order, those sections of the Gas Works Clauses Act, 1847, and the Gas Works Clauses Act, 1871, which relate to the breaking up of streets for the purpose of laying pipes, are incorporated with the Electric Lighting Act, 1882, and are to be read as if "gas" meant "electricity," and as if pipe meant "electric line." (*ib.*, Sec. 12.)

Private streets, courtyards, &c., cannot, however, be broken up unless with the consent of the person, company or other body responsible for the repair of the same, or unless there are special powers conferred upon the undertakers in this behalf. (*ib.*, Sec. 13.)

Obligation on Undertakers to Supply Electricity.—Where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the licence, order, or special Act authorising such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply. (Electric Lighting Act, 1882, Sec. 19.) It might be thought that where undertakers have obtained power to supply a particular area, they are bound to lay such mains as will enable them to grant a supply to every householder in that area. As a rule, however, the provisional order only requires them to lay down mains in specified streets, and to lay other mains after a requisition in that behalf has been served upon them.†

Upon a requisition being made, the undertakers may decline to be bound by it unless the persons by whom it is signed bind themselves to take, or guarantee that there shall be taken, a supply of energy for a period of three years at least, of such amount as will at the rates of charge for the time being charged by the undertakers produce annually such reasonable sum as is specified by the undertakers in the notice (*ib.*, Sec. 25 (1)). The Board of Trade has power to control the amount which may be thus specified by the undertaker (*ib.*).

Duty of Undertakers to Grant a Supply.—While, as has been pointed out, the undertakers are under obligation to supply electricity, they must not, in making any agreements for a supply, show any undue preference‡ to any local authority, company, or person. Subject to this, they may make such charges for the supply as may be agreed not exceeding the limits of price imposed by or in pursuance of their provisional order (Electric Lighting Act, 1882, Sec. 20). They can prescribe any particular form of lamp or burner; but a consumer must not use any lamp or burner which is likely to interfere with the supply to other persons (*ib.*, Sec. 18).

A consumer, however, cannot always have a supply laid on merely upon demand. After serving a notice specifying the premises, the maximum power required and the day upon which the supply is required to commence, the intending consumer must enter into a written contract if required by the undertakers, to receive and pay for a supply of energy for a period of at least two years, of such an amount that the payments to be made for the supply at the rate of charge for the time being charged by the undertakers for a supply of energy to ordinary consumers within the area of supply shall not be less than 20 per cent. per annum on the outlay incurred by the undertakers in providing any electrical lines required to be provided for the purposes of the supply; and if required by the undertakers, must also give security (Electric Lighting (Clauses) Act, 1899, Sched. Sec. 27). It is the practice of companies and local authorities supplying electricity to require intending consumers to enter into a contract. (See Husey *v.* London E.S. Corp. (1902), 1 Ch. 411).

Measurement of Supply.—Provisional orders usually provide that the undertakers may charge for energy supplied by them to any ordinary consumer (otherwise than by agreement):—(*a*) By the actual amount of energy so supplied; or (*b*) by the electrical quantity contained in such supply; or (*c*) by such other method as may for the time being be approved by the Board of Trade (Electric Lighting (Clauses) Act, 1899, Sched. Sec. 31).

Meters.—Supply is, as a general rule, measured and paid for according to the register of a meter which is hired out to the consumer by the undertakers. Elaborate provision is made in the Electric Lighting (Clauses) Act, 1899 (see Schedule, Sub-sec. 49-59), with regard to meters. The undertakers are under obligation to supply meters if required to do so (*ib.*, Sec. 52).

Recovery of Charges.—If any consumer neglect to pay any charge for electricity or any other sum due to the undertakers in respect of the supply of electricity, the undertakers may cut off the supply, and may discontinue the supply until the arrears, &c., are paid.*

Regulations under the Electric Lighting Acts for securing the Safety of the Public.—In accordance with their powers in that behalf, the Board of Trade in 1895† passed a series of regulations under the Electric Lighting Acts with a view to securing the safety of the public. These are too long to be referred to in detail. They provide *(inter alia)* for the maximum pressure of supply at a consumer's terminals; the size of conductors; insulation; use of transformers; support and height of aerial lines; electric lines other than aerial lines; street boxes; transformers and transforming stations; and for the erection and treatment of electric lines and apparatus on consumers' premises.

Private Supply of Electricity.—While electricity is usually supplied in accordance with the terms of a provisional order, there is nothing to prohibit a man from generating electricity and granting a supply to his neighbours upon any terms which may be arranged between them. Prior to 1888, installations of this kind were not even under the control of the Board of Trade, but by the Electric Lighting Act, 1888, Sec. 4, it was provided that where in any case, any electric line or other work may have been laid down or erected in, over, along, across, or under any street, for the purpose of supplying electricity, or may have been laid down or erected in any other position for such purpose in such a manner as not to be entirely enclosed within any building or buildings, or where any electric line or work so laid down or erected may be used for such purpose otherwise than under and subject to the provisions of a licence, order or special Act, the Board of Trade may serve upon the owner a notice to the effect that the lines shall only be continued and used in accordance with the rules and regulations which the Board have made for the protection of the public safety. (See

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* This phrase will be used throughout to denote the local authority or the company as the case may be.

† It is provided by Sec. 21 (1) of the Schedule to the Electric Lighting Clauses Act, 1899, (which is usually incorporated with every provisional order) as follows:—"The undertakers shall, within a period of two years after the commencement of the special order, lay down suitable and sufficient distributing mains for the purposes of general supply throughout every street or part of a street specified in that behalf in the special order, and shall thereafter maintain those mains. (2) In addition to the mains hereinbefore specified the undertakers shall at any time after the expiration of 18 months after the commencement of the special order lay down suitable and sufficient distributing mains for the purposes of general supply throughout every other street or part of a street within the area of supply, upon being required to do so in manner provided by the special order."

Sec. 24 (1), which relates to the requisition provides that:—"Any requisition requiring the undertakers to lay down distributing mains for the purposes of general supply throughout any street or part of a street may be made by six or more owners or occupiers of premises along that street or part of a street, or where the local authority are not themselves the undertakers and have the control and management of the public lamps in that street or part of a street by the local authority."

‡ As to what constitutes "an undue preference," see Metropolitan E.S. Co. *v.* Ginder (1901) 2 Ch. 799.

* Electric Lighting Act, 1882, Sec. 21. As to the liability of an incoming tenant, see Gasworks Clauses Act, 1871, Sec. 39, which is incorporated with the Electric Lighting Act. See also Paterson *v.* Gas Light and Coke Co. (1896) 2 Ch. 476; Husey *v.* Gas Light and Coke Co. (1902) 18 T.L.R. 299.

† In so far as they relate to pressure of supply they were modified in 1901.

regulations under Sec. 4 of the Electric Lighting Act, 1888, made by the Board in 1897.)

Subject to compliance with those regulations, which provide for maximum pressure, insulation, the use of aerial lines, &c., a private person may supply electricity upon any terms he chooses; and this whether there is a provisional order in operation in his district or no. He may even send his wires across a highway if (*a*) they are suspended at such a height that they do not interfere with the traffic; (*b*) the soil of the highway is vested in the owners on either sides who give their consent to the suspension of the wires (see Finchley E.L. Co. *v.* Finchley U.D.C. (1902), 1 Ch. 866). The operations of a person who is privately supplying electricity may, however, be limited by the fact that he cannot up-root the surface of a highway for the purpose of laying his mains.

The foregoing observations with regard to the use of overhead wires are subject to the reservation that in London, overhead wires are subject to the special legislation (London Overhead Wires Act, 1891 (54 and 55 Vict. c. lxxvii.)). Again, it is competent for urban authorities, who have adopted the Public Health Acts Amendment Act, 1890 (53 and 54 Vict. c. 59) to from time to time make, alter and repeal by-laws for the prevention of danger or obstruction to the public from posts, wires, &c., along or across any street. The Act, however, does not extend to any works of any undertakers within the meaning of the Electric Lighting Acts, 1882 to 1888, to which the provisions of those Acts apply (P.H.A. Amendment Act, 1890, Sec. 15).

(*To be concluded.*)

THE NEUTRAL MARKETS OF THE WORLD: THEIR OPPORTUNITIES.

VII.—Mexico.*

Of all the Central and South American Republics, Mexico offers, perhaps, the greatest opportunities for the extension of trade in electrical goods. The country possesses an abundance of water supply suitable for power purposes, the interior is rapidly being opened up by means of railways, there is a shortage of coal for industrial purposes, the towns and cities are being rapidly extended and improved, so that in all directions there should be considerable opening for the application of electricity for lighting, power and traction purposes. In recent years, the Government and people alike have made strenuous efforts to place Mexico in the first rank; a pronounced activity has been shown in commercial and financial circles in the country, and at present Mexico is more prosperous than at any other period of her history.

The Republic covers an area of 767,326 sq. miles, and has a population of about 15,000,000. The total imports in 1903-4 amounted to £15,661,688, of which £8,571,754 were from the United States, £2,003,230 from the United Kingdom and £1,908,216 from Germany; in 1902-3 the imports amounted to £15,180,961, of which £8,102,909 were from the United States, £2,123,069 from the United Kingdom and £1,914,802 from Germany. It will thus be seen that the imports from the United States showed an increase in 1903-4, whilst those from Germany and the United Kingdom showed decreases. In the case of the United Kingdom this decreased trade continued during the six months from July to December, 1904, whilst the imports from the United States and Germany increased, the latter country ousting the United Kingdom from the second place amongst the supplying countries. The total imports have more than doubled since 1893-4; the imports from Germany are nearly four times what they were in that year; the imports from the United States have nearly trebled, whilst those from the United Kingdom have barely doubled. Thus it will be seen that the United Kingdom has by no means gained her share of the total trade with Mexico. United States manufacturers are certainly at an advantage owing to their proximity to the market, but they have done much to increase their trade by personal efforts, by the sending of commercial travellers, and by an extensive system of advertising. It now appears that the United Kingdom must also fall behind Germany as regards her trade with Mexico. German manufacturers are at present showing a considerable interest in this market, and are greatly assisted by a good service of steamships anxious to obtain freight. The imports of machinery and implements in 1903-4 amounted to £2,124,495, as against £2,067,417 in 1902-3; by far the larger part comes from the United States, whilst the United Kingdom, Germany, France and Switzerland share the remainder. The total exports in 1903-4 amounted to £19,669,051, as against £19,772,897 in 1902-3; of the former amount £14,153,718 were entered as exported to the United States, but this figure is somewhat misleading, as a large quantity of goods are sent to the United States for reshipment.

Statistics of the imports of particular classes of goods are not available for years later than 1902-3. In that year the imports of copper, brass, and bronze sheets, &c., amounted to $79,193, of which $35,737 were from Germany, $24,511 from the United States, and $18,421 from the United Kingdom. The imports of copper wire amounted to $25,973; $2,549 being from Germany, $18,267 from the United States, and $2,031 from the United Kingdom. The imports of copper wire covered with cotton, silk, paper, &c., were valued at $1,298, of which $1,059 were from the United States. Copper wire, insulated for electric lighting, was imported to a value of $468,677; the imports from Germany were $44,560, from United States $368,907, and from the United Kingdom $52,548. Insulators of glass or porcelain for electric conductors were imported to a value of $20,926; $4,458 from Germany, $12,788 from United States, and $2,340 from the United Kingdom. The imports of electric batteries were valued at $105,395, of which $16,610 were from Germany, $67,194 from United States, and $1,946 from the United Kingdom. Incandescent electric lamps were imported to a value of $72,062, of which $19,811 were from Germany, $42,108 from United States, and $2,430 from the United Kingdom. The imports of lifts were valued at $14,942; $146 from Germany, and $13,676 from United States. Arc lamps were valued at $22,577; $7,802 from Germany, and $14,160 from United States. Steam machines were imported to a value of $3,231,829, $81,594 from Germany, $2,844,878 from United States, and $274,653 from the United Kingdom; machines for whatever purpose not enumerated, with motors, &c., to a value of $4,207,275, $405,200 from Germany, $3,012,983 from United States, and $623,391 from the United Kingdom; machines and apparatus for industry, agriculture, &c., to a value of $1,055,209, $112,746 from Germany, $907,166 from United States, and $12,266 from the United Kingdom. Railway carriages were imported to a value of $930,253, $4,408 from Germany, $747,239 from United States, and $178,022 from the United Kingdom.

It will be seen from these figures that the predominance of United States goods on the Mexican market generally also extends to the trade in electrical goods. Although, as stated above, this state of affairs is due partly to proximity to the market, it is also due to a great extent, to the investment of American capital in electrical enterprises in the country, and to the push and persistency of the American manufacturer. Great developments are still being made in the Republic, and by the sending of capable commercial travellers, the employment of reliable agents, and an extensive system of advertising, it cannot be doubted that British manufacturers, given better steamship communication, could considerably increase their trade with this important market.

Manufacturing in Mexico can only, as yet, be said to be in its infancy, but it is bound to grow very rapidly within the next few years; up to the present, mining and agriculture have been the chief occupations of the people, but the country is now alive to the fact that great quantities of water power available for industrial purposes are lying idle. There are only very few large streams in the Rupublic, but owing to the mountainous nature of the greater part of its surface there is an abundance of small streams, which, owing to their rapidity and the extent of their fall, offer a great amount of power which could easily be utilised. It must, however, be admitted that certain obstacles present themselves as regards some of the Mexican rivers, which have dry beds for about six months of the year. In some cases of this nature where water-power is now being utilised for electrical purposes, coal or other fuel is used during the dry season. The exclusive use of coal or other fuel for generating steam to run the plants would render the cost of their operation prohibitive to profits, but by using the water power for some six months of the year this cost is considerably reduced. Another great obstacle is that of vegetable growths, such as water hyacinths, which impede the use of water from streams infested with them. A very small proportion of the available water is at present being utilised. Dr. Antonio Penafiel gives the amount of power in use in Mexico at (I.H.P.) 66,008 steam, 32,147 water, and 17,828 electric. Concessions are continually being granted for the appropriation of water-power; in 1904-5 concessions were granted for the utilisation of 52,150 litres of water per second to generate power on the Angulo, Lerma, San Geronima, Atoyac, Nexapa, Conchos, and Baluarte.

Among the most noteworthy enterprises in the development of electric power from water in Mexico is that of the Mexican Light and Power Co., incorporated in Montreal in 1902, with Canadian capital. The power is obtained from the Nexaca and Tenango rivers in the State of Puebla, a distance of 92 miles from Mexico City. The force generated by means of turbines of 7,500 H.P. each, with a potential of 60,000 volts, will be carried to the City of Mexico, as well as supplying the important mining camp El Oro, at a distance of about 170 miles from the central plant. It was anticipated that 40,000 H.P. could be distributed for industrial and lighting purposes, but as the demand for electric power is greater than was expected, it has been decided to duplicate the installation and erect another 40,000 H.P. plant at a distance of 3 miles from the original station. This company has acquired all the shares of the Cia. Mexicana de Electricidad, Ltd., possessing a steam generating plant of 9,000 H.P. capacity at Nonoalco, a suburb of the capital. The Mexican Gas and Electric Light Co., of London, with plant at San Lazaro, was publicly opened in December, 1904. The plant

* The previous articles of this series have been published as follows:—

I. Argentine Republic, Elec. Rev., March 9th, p. 411.
II. Brazil, Elec. Rev., March 23rd, p. 493.
III. Chile, Elec. Rev., March 30th, p. 531.
IV. Peru, Elec. Rev., April 13th, p. 619.
V. Paraguay and Uruguay, Elec. Rev., April 27th, p. 699.
VI. Bolivia and Colombia, Elec. Rev., June 8th, p. 939.

includes a battery of 13 marine type boilers, having a total capacity of 6,000 H.P., together with independently fired steam superheaters. The underground cable system is the most extensive in the republic, and comprises over 100 miles of underground mains. The Cia. de Fuerzas Hydro-electricas de San Ildefonso, Ltd., produces its principal power from a waterfall about 12 miles from Mexico City; it has an auxiliary steam plant for use during the dry season. In the Canada of Contreras, Messrs. Robert & Co., by means of a series of turbines driven by water from the Churubusco River, produce from 500 to 600 H.P., which is used during the day in the cotton-mills of Contreras and at night for lighting the suburbs of Tlalpam, Coayocan, Mixcoac, San Angel Tizapan and Tacubaya. Not far from Mexico City, at Puchuca a local company produces for distribution among the mines 2,000 H.P., the electricity being generated from water-power. The Guanajuato Electric Light and Power Co. has its power house situated on the Duero River near Zamora, in the State of Michoacan, with a capacity of 8,000 H.P.; power for lighting, mining and other purposes is transmitted to Guanajuato on an aerial wire. The town of Leon is also furnished with power from the above plant, whilst the town of Guadalajara is supplied from the Juanacatlan Falls of the River Lerma. This part of Mexico has an immense potential of water-power, which will, no doubt, be utilised for electrical purposes. Many cotton mills in the district of Orizaba are now driven by water-power, and the Tezuitlan Copper Co. has a plant at Tezuitlan, in Puebla, for generating electrical power. As stated above, numerous concessions have been granted by the Department of Public Works to companies and individuals for the utilisation of water-power from the streams of the Republic for generating power; the Government is fully awake to the desirability of having the water-power of the country developed, and offers very liberal terms to *bonâ fide* companies and individuals. Electric railways are in operation in Mexico City and Torreon, and the following amongst other towns will shortly adopt this system of traction:—Guadalajara, Agnascalientes, Monterey, Lagos, Colima, Vera Cruz, and San Luis Potosi. Electricity has already been applied to some extent to mining, and in view of the available water-power and the consequent cheapness of production of electrical power, there should be a great opening in Mexico for the utilisation of this power for driving the mining machinery as well as for treating and carrying the ores.

In all directions Mexico is being wonderfully developed; a huge network of railways is to be constructed to unite distant interior parts of the republic with the seaports; railroads are being built by private capital backed by Government concessions; rich mining and agricultural districts are being opened up; irrigation works are being carried out; and in all branches of enterprise Mexico offers a great field for the investment of capital and the extension of trade. The General Administration of Telegraphs has recently ordered the construction of an extensive network of telegraph lines in Lower California touching all the principal cities and towns of that territory. Moreover, in view of the good results which have been obtained by the installation of wireless telegraphy in Cabo Haro and San Rosalia, it has been resolved to make new installations in different places on the coast of Lower California in combination with other stations which will be established in Sonora and Sinaloa.

The following duties are leviable on electrical goods, &c., imported into Mexico:—Wire of copper, brass, bronze, or white metal covered with any material, 10 cents per kilog. gross; ditto, not covered with any material, 6 cents per kilog. gross; cable without copper, &c. core, covered with any material and cable uncovered 6 cents per kilog. gross; cables provided with cores and covered with any insulating substance, free; insulators of glass, crockery and porcelain, 1 cent per kilog. gross; globes for incandescent electric lighting, switches, light extinguishers, contacts and their pins, fusibles, circuit closers, rings and detents, 11 cents per kilog. gross; electric arc lamps (glass globes not included, they pay duty as worked glass according to classification), 6 cents per kilog. gross; machinery of all kinds for industrial, &c., purposes, not specially mentioned, and loose parts thereof and extra pieces, $1·65 per 100 kilogs. gross; railroad cars and coaches, free. By gross weight is meant the weight of the goods with all their outside and inside coverings. For one year from July 1st, 1905, foreign goods imported into the territory of Quintana Roo exclusively for consumption therein are admitted free of duty. The import duties levied on machines for mines or metallurgical establishments treating precious metals are refunded on application by the importer. When making shipments of machinery, it should be stated in *pro forma* invoice or packing list whether it is to be worked by steam, hydraulic, electric, horse, hand or foot-power; machinery susceptible of operation by hand or foot-power pays a higher rate of duty even though it is intended to be worked by steam, hydraulic or other pressure. When shipping goods which are not clearly classified in the tariff, all possible data should be furnished to the Customs agents in order that they may properly "assimilate" the goods.

Almost the entire distribution of British goods in Mexico is done through the hands of foreigners, there are few British houses of any importance in the country. The following are some of the firms dealing in electrical supplies:—

Mexico City.—Mexican Telegraph Co., 293 calle Caja; Mexican Electric Street Railway Co.; Mexican Electric Supply and Construction Co.; Mexican Electric Works, Ltd.; Mexican General Electric Co., 403 calle Apartado; Agencia Edison, 3 Santa Caterina 4; J. M. Gonzalez Medina, 4 Estanco de Mujereo; Beigner and Co.; C. W. Evans, 7 calle San Francisco; Mexican Gas and Electric Light Co., 7 Santa Clara; S. C. Peck, Plazuela de Guardiola; J. Arca y Cia, 1 calle San Francisco; R. C. Bateman, 7 calle Capuchinas; Roberto Boker & Co., 1 calle Coliseo Viejo; G. & Y. Braniff & Co., 19 calle Cadena; V. M. Braschi & Co., 2 calle Cadena; Cia. Explotadora de Fueza Hidro Electricas Motriz San Ildefonso, 9 calle Don Juan Manuel; Gardner & Shearer, 404 Av Juasez; Haaga & Schmid, 6 Callejon Cuajamulco; Waldemar Julsrud & Co., 20 calle Coliseo Viejo; Korff, Honsberg & Co., 4 Puente de Esperitu Santo; G. Lohse & Co., 10 calle Palma; Mexico Mine and Smelter Supply Co.; Siemens & Halske; Sommer Hermann & Co.; 4 calle Palma; Cia. Telefonica Mexicana.

Agnascalientes.—Doerr Bros.

Chihuahua.—Compania Telefonica de Chihuahua y Durango.

Parral.—Cia. de Comercio del Parral (telephone, lighting, and power).

Toluca.—Toluca Electric Light and Power Co.

Monterey.—Electric Light and Power Co., Ltd.

Puebla.—Portezuelo Electric Light and Power Co.

San Luis Potosi.—Cia. Luz Electrica de San Luis Potosi.

Mazatlan.—Arthur de Cima.

Jalapa.—Jalapa Electric Light and Power Co.

Merida.—Agnew & Co.

Guadalajara.—Soc. Anon. La Electrica; R. H. Beach; C. Jackson, 27 calle Apartado.

Durango.—Durango Electric Light Co., 12 calle Victoria.

Guanajuato.—Guanajuato Power and Electric Co.; A. Saavedra.

Tampico.—Tampico Municipal Electric Works.

Zacatecas.—E. Sandoval.

Salina Cruz.—Central and South American Telegraph Co.

Celaya.—Celaya Electric Light Works.

Monclova.—D. Degetan.

Morelia.—Morelia Electric Light Works.

Quezaltenango.—Cia. del Alumbrada Electrica.

Manufacturers should issue price lists and catalogues in Spanish with prices in United States or French currency, and should see that they are placed in the hands of merchants interested in their goods. The most important requisite for doing successful business is to send travellers with a knowledge of the Spanish language and familiar with trade conditions to visit the Republic at least once a year. A great deal of success may be obtained by a thorough system of advertising in good Mexican papers circulating in the interior. Firms who find it impracticable to send travellers throughout the country should secure reliable representatives, and should keep them well supplied with advertising matter, catalogues, &c.

The rates of taxes payable by commercial travellers vary considerably in the different States of Mexico, and in many cases municipal taxes are levied in addition to the State taxes; the amount of the tax depends in several cases on the decision of the local official. In the State of Mexico itself no tax is levied on commercial travellers, but the Government require a commission of 6 per cent. on transactions with private parties; commercial travellers must, however, obtain a licence. In cases where samples brought by a commercial traveller are dutiable under the tariff law, the traveller may furnish a bond for twice the amount of the duties leviable. This bond is cancelled if the samples are taken out of the country through the same Custom House and in the same condition as when they were taken in.

THE EARTHING OF THE MIDDLE WIRE.

THIS much discussed question has been dealt with once more in a paper by F. Erens in the *Elektrotechnische Zeitschrift*, the conclusion arrived at being that the insulated middle wire earthed only at the station is preferable to the bare middle wire earthed all along.

The advantages of the bare wire earthed all along have been stated as:—

1. Reduced cost.
2. Reduced interference with telephone lines.
3. Increased safety of supply.
4. Improved voltage regulation with unequal loads on the two sides,

and the paper discusses these four points in detail.

1. Stated as a percentage of its own cost, the difference between an insulated and an uninsulated middle wire is, of course, considerable, but considered in relation to the total cost of the installation this difference is pratically negligible—probably not exceeding 2 per cent. or 3 per cent. This difference is further reduced by the fact that experience has shown that the life of bare conductors is shorter than that of insulated ones. Of recent years an attempt has been made to get over this difficulty by giving the cable a lead covering protected with impregnated jute. The cost of this, however, still further reduces the difference between the bare and insulated cables, and it is doubtful whether the life of the bare cable is appreciably increased.

2. The question of telephonic disturbances was of considerable importance some years ago when practically all telephone lines were single lines with earth returns, but since double lines have been almost universally adopted the insulated and the bare cable arrangements are equally harmless.

3. The increased safety of the bare wire is explained on the ground that if an earth occurs on one of the outers, the fuses in that outer will blow more quickly and certainly if the middle wire is bare than if it is insulated and only earthed at the station. This is correct, but the difference between the two cases is much smaller than is usually supposed. The resistance of the earth path is

known to be very small; some experiments carried out by Thury (*E.T.Z.*, 1905, p. 76) indicate that the resistance over a distance of 58 kilometres even in rocky ground is negligibly small. It is, therefore, quite safe to assume that in the case of a town whose roads are intersected by gas and water pipes, there will be little difference between the resistance of the earth alone and that of the earth in parallel with a bare conductor of normal dimensions, so that the fuse would be likely to blow practically equally quickly with the bare and with the insulated middle wire.

Cable breakdowns should and do occur very seldom in a properly-designed installation, and experience has not shown that they are any less frequent with the bare middle wire than with the insulated

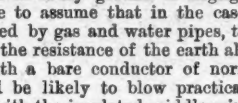


Fig. 1.

wire. The bare middle wire also forms no certain safeguard against double the normal voltage occurring across one side of the system in the event of an earth on the other side.

4. The voltage equalisation between the two sides of the system will undoubtedly be better with the bare wire than with the insulated one. This is because in the first case the low resistance earth path is available as well as the middle wire. With a middle wire of usual proportions, however, the voltage variations due to this cause are in any case small and, if necessary, a slight increase in the middle wire section will, without materially increasing the cost of the installation, make the insulated wire as effective as the bare wire.

Having disposed of the objections to the insulated middle wire, the writer proceeds to discuss some of its advantages.

With the bare wire small earth leakages of, say, 20 amperes, are very difficult to detect, as waste current flowing to earth is in no way distinguishable from current taken by the consumers. Unless, therefore, an independent insulation test of each feeder in turn is made, these small leakages can continue indefinitely and have often

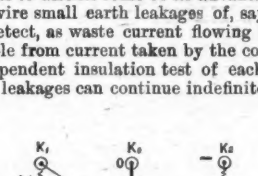


Fig. 2.

caused the gradual destruction of considerable lengths of the lead covering of the outer cables. The same leakages can, of course, occur with the insulated middle wire, but in this case it is easy to determine their amount by a systematic measurement of the current passing through the single earth connection in the middle wire. It is best to employ two ammeters (fig. 1)—a heavy current one left permanently in circuit, and a low-reading instrument inserted in place of the other when required. An objection to this arrangement is the fact that if both outers have faults on them the ammeter only indicates the difference. This is not so serious an objection as it appears, for experience has shown that if the readings are taken regularly and each earth fault is rectified as soon as it occurs, there will be little likelihood of both outers ever having simultaneous faults on them.

It is further possible, by means of a few additional readings, to determine the insulation of each outer separately, even whilst the supply is in operation. The connections for this are shown in fig. 2; r_1 and r_2 are the two unknown insulation resistances, i_1 and i_2 are the two currents to earth and i_0 is their difference as read on the middle wire ammeter A, P_1 and P_2 are the voltages of the two outers measured to earth. Then

$$i_0 = i_1 - i_2$$
$$P_1 = i_1 \times r_1$$
$$P_2 = i_2 \times r_2.$$

One of the outers (say the positive one) is next connected to earth through a resistance. The current J_1 in this resistance is then measured as well as the altered values of the current in A ($= J_0$), and the voltages of the outers to earth ($= P_1'$ and P_2'). The currents to earth will also have altered. Let these be i_1' and i_2'.

Then
$$J_0 = i_1' + J_1 - i_2'$$
$$P_1' = i_1' \times r_1$$
$$P_2' = i_2' \times r_2.$$

From the above six equations the values of r_1 and r_2 work out as follows:—

$$r_1 = \frac{\frac{P_1}{P_2} - \frac{P_1'}{P_2'}}{\frac{J_0 - J_1}{P_2'} + \frac{i_0}{P_2}}$$

and

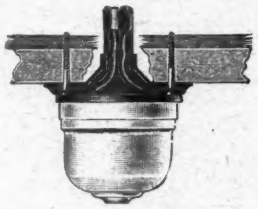
$$r_2 = \frac{\frac{P_1}{P_2} - \frac{P_1'}{P_2'}}{\frac{P_1}{P_2'}(J_0 - J_1) + \frac{P_1'}{P_2} i_0}.$$

It will be seen that the measurement of these two currents and four voltages enables the actual insulation resistance of each outer to be determined at any time in a few minutes, and so prevents the possibility of an earth current of even small amount existing undetected for long. This, by increasing the likelihood of uninterrupted supply, constitutes a decided advantage for the insulated over the uninsulated middle wire arrangement.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Simplex Flush Mounting Box.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have brought out new patent arrangements to take the place of wooden blocks for mounting switches, ceiling roses, &c. They are specially intended for use on concealed work, and are, therefore, designed with the minimum of depth, to reduce the depth of channelling in brick work. The boxes are made of brass, polished and lacquered, and provide space for slack wire; they can



Simplex Flush Mounting Box with Ceiling Rose.

be used in conjunction with wood casing, with the addition of a flanged plate. The fitting is separated from the box by means of an insulating disk $\frac{1}{8}$ in. thick. Amongst other advantages, it is claimed that with this device, the wires are totally enclosed in metal throughout; no plaster is required; screws cannot be put through the wires during erection; perfect insulation is obtained, labour is saved, and an artistic finish is secured.

Portable Micro-Ammeter and Milli-Voltmeter.

A further advance has been made by Mr. R. W. Paul, of Newton Avenue Works, New Southgate, N., by the addition to his already large variety of handy instruments of a portable instrument

Fig. 1.

arranged to measure currents from one-millionth of an ampere to 0·12 ampere, and pressures from one ten-thousandth to 2·4 volts with a high degree of accuracy. This result is attained by the combination of a micro-ammeter with sets of shunts and series resistances giving eight ranges. The instrument is of the moving-

coil type with spring control, and is of the ingenious single-pivot pattern introduced by Mr. Paul, having a sensibility enormously greater than that of the old two-pivot type, together with perfect portability.

The general appearance of the set is shown in fig. 1; the scale is practically uniformly divided, with a fine pointer and a mirror, and the movement is nearly dead-beat. When the lid is closed the coil is automatically lifted from the pivot and clamped. The zero is easily adjusted if required. At the right-hand side of the case is the single sliding switch which effects all the changes in the connections, of which a diagram is given in fig. 2. There are only two terminals, for simplicity's sake, and a main switch. The resistance of the copper coil is 50 ohms, and as the resistance in series with it is nearly 10,000 ω when the deflection is 100 divisions for one volt, the temperature coefficient is practically negligible.

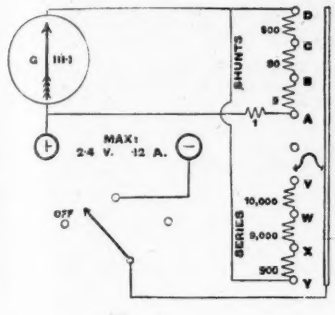


FIG. 2.

At the highest sensibility each division of the scale (which is calibrated throughout) corresponds with one-millionth of an ampere.

The measurement of small currents and pressures is of course only a portion of the functions of this instrument; by adding external shunts, currents of any magnitude can be measured, and a shunt giving a range of 120 amperes can be fitted in the lid of the instrument without increasing its dimensions, while external series resistances enable high pressures to be dealt with. The whole thing weighs 8 lb., and measures 10 in. × 7 in. × 5 in.

A modification of this set is also made, which can be used for pressures up to 600 volts, and has three ranges in addition to the eight ranges of the simpler type. This set is suitable also for measuring insulation resistances up to 500 megohms with 500 volts.

New Portable Soldering Stove.

The accompanying illustration shows a new patent device introduced by Mr. A. H. HUNT, of 115-117, Cannon Street, E.C. This, as its name suggests, is a stove which is used not merely to heat a soldering bit, but to effect the soldering; it is, in fact, in one with the bit! The stove consists of a strong sheet-iron box through which the copper bolt passes, with a hinged top for refilling with charcoal, and a damper to regulate the temperature. It is manipulated with the wooden handle shown, and can be used in any position. Porcelain feet are provided, to prevent injury to woodwork when the stove is set down, and a small chimney is used to help to start the fire, with a small spirit lamp to ignite the charcoal. It is easily managed, and cheap in operation; the copper bit is not liable to get dirty or burnt, and is always hot after six minutes from lighting up. Such a handy tool as this appears to be should prove exceedingly useful.

THE "SUN" PORTABLE SOLDERING STOVE.

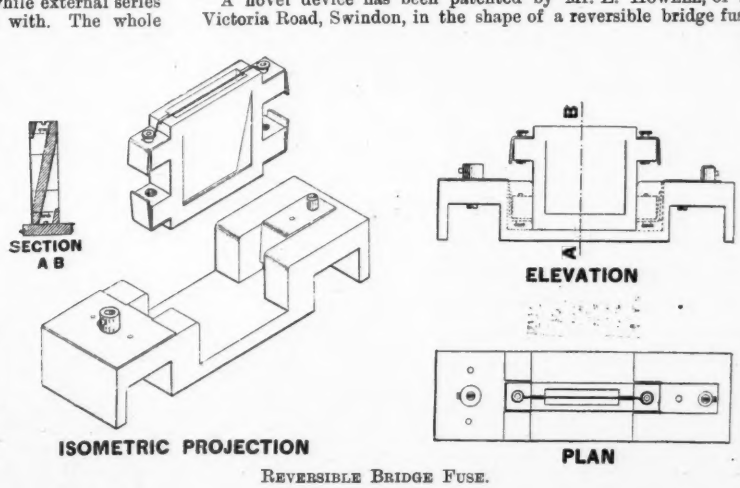
Electrical Ambulance.

It will be remembered that the City Corporation has resolved to introduce a service of electrical ambulances for the City streets. We understand that one such vehicle is to be supplied by the ELECTROMOBILE CO., LTD., of Curzon Street, W. This company has already supplied such a conveyance to the Metropolitan Asylums Board, which we are enabled to show in the accompanying illustration. E.P.S. batteries are being used.

ELECTROMOBILE AMBULANCE.

Reversible Bridge Fuse.

A novel device has been patented by Mr. L. HOWELL, of 10 Victoria Road, Swindon, in the shape of a reversible bridge fuse, which we illustrate herewith. It will be seen that a spare fuse is provided, which can be placed in circuit instantly by reversing the bridge; the spent fuse can be replaced at leisure, without interrupting the circuit or touching the live contacts. Both fuse wires are always in sight, and they are quite independent of one another. The fuse is otherwise of simple design and construction, and appears to be a good thing.



REVERSIBLE BRIDGE FUSE.

"Excello" Arc Lamps.—In connection with Prof. S. P. Thompson's British Association lecture to artisans, for the purpose of demonstrating the very large improvements in lighting devices, the lecturer had a monster "Excello" arc lamp similar to the one exhibited at the recent Olympia Electrical Exhibition, which was the object of so much interest. All the arrangements in connection with it were made by MESSRS. BAXENDALE & CO., who are agents for that class of lamp for the Manchester district.

Gold Medal.—THE FRICTIONLESS ENGINE PACKING CO., LTD., have been awarded the gold medal at the Tourcoing Exhibition (France) for their "Karmal" engine packings and "Roko" edge belting.

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

3,677A. "Improvements in the regulation of alternating current circuits subject to fluctuations of load." SIEMENS BROS. & Co., LTD. (Siemens Schuckertwerke Ges., Germany.) (Date applied for under Rule 5 of the Patents Rules, 1905, February 14th, 1906.) August 2nd.

17,115. "Method of making dynamo brushes." G. PREUSS. (Date applied for under Patents Act, 1901, July 28th, 1905, being date of application in Germany.) July 30th. (Complete.)

17,130. "Improvements in telegraphy." P. B. DELANY. July 30th. (Complete.)

17,166. "Improvements in apparatus for protecting electric circuits against excessive current strengths." SIEMENS BROS.' DYNAMO WORKS. (Siemens-Schuckertwerke Ges., Germany.) July 30th. (Complete.)

17,171. "Improvements in or connected with the track of tramways and railways in which vehicles are propelled electrically on the surface-contact system." E. A. MITCHELL. July 30th.

17,172. "Improvements in or relating to surface-contact electric traction systems." E. A. MITCHELL. July 30th.

17,174. "Improvements relating to electrical conduction." E. W. BUCKERIDGE and G. H. BUCKERIDGE. (Date applied for under Patents Act, 1901, being date of application in New Zealand.) July 30th. (Complete.)

17,201. "Improved device for collecting and transmitting electrical energy." J. R. FROST. July 31st.

17,226. "Improvements in electro-magnetic devices for the obtaining of a sequence of effect as applied to automatic controlling devices and the like." R. A. SMITH and H. LINZELL. July 31st.

17,236. "Improvements in multi-speed electric motors." W. E. BURNAND. July 31st.

17,255. "Improvements in direct-current dynamo-electric machines." J. Y. JOHNSON. (Felten & Guilleaume Lahmeyerwerke Aktien Gesellschaft, Germany.) July 31st. (Complete.)

17,259. "Improved construction of appliances for producing electric light displays." H. N. DAKHYL and A. GALANTI. July 31st.

17,272. "Improvements in apparatus applicable to electric signalling." C. L. WALKER. July 31st.

17,293. "Improved automatic electric fire alarm." C. W. MOULE and and W. M. HASELL. August 1st.

17,318. "Improvements in and relating to means or apparatus for automatically controlling the speed of alternating-current commutator motors." CROMPTON & Co., LTD., J. C. MACFARLANE and H. BURGE. August 1st.

17,321. "Improvements in electrically-controlled lifts or hoists." R. WAYGOOD & Co., LTD., and H. C. WALKER. August 1st.

17,338. "Improved construction of regenerate electric battery." W. MOORES and G. PETRIDES. August 1st.

17,342. "Improvements in connection with electrical sterilising apparatus." FELTEN & GUILLEAUME-LAHMEYERWERKE AKT. GES. (Date applied for under Patents Act, 1901, August 1st, 1905, being date of application in Germany.) August 1st. (Complete.)

17,343. "Improvements in electrical current interrupters." FELTEN AND GUILLEAUME-LAHMEYERWERKE AKT.-GES. (Date applied for under Patents Act, 1901, August 18th, 1905, being date of application in Germany.) August 1st. Complete.)

17,349. "Improvements in wheels for overhead trolley for electric cars." J. H. NORTHCOTT. August 1st.

17,355. "Improvements in and connected with dynamo-electric machines." H. O. FARRELL. August 2nd.

17,361. "Improvements in the manufacture of cycle and motor-head lock rings." E. A. RANDALL. August 2nd.

17,384. "Electric circular rim and lever for nickel plating barrels." C. C. WALKER. August 2nd.

17,404. "Improvements in fittings to be used in connection with electric lighting." B. T. DAVIES. august 2nd.

17,419. "Improvements in switches or line selectors for telephones and the like." B. HAHNER. (Date applied for under Patents Act, 1901, November 14th, 1905, being date of application in Germany.) August 2nd. (Complete.)

17,434. "Improvements in and relating to electric metering apparatus." ALLGEMEINE ELEKTRICITATS-GES. (Date applied for under Patents Act, 1901, August 2nd, 1905, being date of application in Germany.) August 2nd. Complete.)

17,447. "Improvements in electric clocks and like instruments." M. M. MCHARDY and G. B. BOWELL. August 2nd.

17,459. "Improvements in connection with electrical machines having fly-wheels." FELTEN & GUILLEAUME-LAHMEYERWERKE AKT.-GES. (Date applied or under Patents Act, 1901, November 21st, 1905, being date of application in Germany.) August 2nd. (Complete.)

17,490. "Improvements in trays for vessels or containers of storage electric batteries or accumulators." H. WHITE. August 3rd.

17,500. "Improvements in inclined carbon arc lamps." VERITYS, LTD., and F. S. WORSLEY. August 3rd. (Complete.)

17,513. "Improvements in electric arc lamps." W. F. BUTCHER, F. E. BUTCHER and F. BROWN. August 3rd.

17,515. "Improvements in telephone call boxes." J. H. STEWART. August 3rd.

17,526. "Improvements in electrical alarm thermometers and like instruments." H. T. HAGERTY. August 3rd.

17,537. "Improvements in and relating to electric accumulators." C. HAUNZ and A.B.P. ACCUMULATOR Co., LTD. August 3rd.

17,538. "Improvements in and relating to electric accumulators and the like." C. HAUNZ and A.B.P. ACCUMULATOR Co., LTD. August 3rd.

17,539. "Improvements in and relating to electric accumulators." C. HAUNZ and A.B.P. ACCUMULATOR Co., LTD. August 3rd.

17,540. "Improvements in and relating to electric accumulators." C. HAUNZ and A.B.P. ACCUMULATOR Co., LTD. August 3rd.

17,560. "Improvements in dynamo-electric machines." C. P. STEINMETZ. Date applied for under Patents Act, 1901, August 7th, 1905, being date of application in United States.) August 3rd. (Complete.)

17,561. "Improvements in and relating to systems of electric distribution employing transformers and controlling apparatus therefor." THE BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) August 3rd.

17,564. "Improvements in and relating to electro-mechanically operated valves." E. L. WHITE and E. C. HOEGERSTAEDT. August 3rd.

17,585. "Telephone support." R. M. HELMER. August 4th.

17,589. "Improved means for securing shades of silk, paper or like materials to inverted incandescent gas lamps, electric lamps and the like." H. J. ELLIS. August 4th.

17,601. "Improvements in magneto-electric generating apparatus especially suitable for ignition of internal combuston engine." J. C. FULLER, G. FULLER, L. FULLER and B. J. MOORE. August 4th.

17,614. "Improvements in materials for transmitting electric currents." H. ROCHLING and W. RODENHAUSER. August 4th. (Complete.)

17,615. "Improved means for obtaining thin liquid dross in electric furnaces for metallurgical purposes." H. ROCHLING and W. RODENHAUSER. August 4th. (Complete.)

17,617. "Improved process for the rapid production of electrotypes." S. O COWPER-COLES. August 4th.

17,668. "Improvements in fittings and connections for electrical incandescence lamps." W. R. LAMBERT. August 4th.

PUBLISHED SPECIFICATIONS.

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CONSTRUCTION OF INSULATOR DEVICE FOR CONNECTING ELECTRIC LAMPS TO THEIR SUPPORTS. L. C. H. Mensing and Bruce Peebles & Co. 19,967. October 3rd.

SOUND BOXES FOR PHONOGRAPHS, TELEPHONES, AND THE LIKE. P. Lebiedzinski. 21,661. October 24th.

ELECTRICAL STORAGE BATTERIES. A. E. Knight. 22,673. November 6th. (Date applied for under International Convention, November 16th, 1904.)

A New Use for Electrolytic Hypochlorite.—In our remarks upon the Hermite installation at Poplar, we alluded to the earlier attempts to use electrolytic hypochlorite solutions for the purpose of sewage treatment. We then urged that while the sterilisation of an effluent was feasible commercially, the sterilisation of crude sewage was impossible commercially, because of the large quantities of available chlorine immediately consumed. In a paper recently read at the Congress of the Royal Sanitary Institute at Bristol, a further field of usefulness for electrolytic hypochlorites was described by Dr. S. Rideal and Mr. R. Orchard. In the treatment of drinking water, even less available chlorine is required to secure sterilisation than in the case of a chemically satisfactory sewage effluent containing organic matter. Therefore the initial oxidation loss disappears and smaller quantities are required. The paper was entitled "The Prevention of the Growth of Algae in Water Supplies," and commenced by pointing out that the fouling of reservoirs and conduits in waterworks by various growths is a problem frequently confronting the waterworks engineer. In America and in tropical countries this is often a serious matter, while on the Continent several Commissions have been appointed to deal with the matter. These contaminating growths in addition to clogging valves impart disagreeable odours and tastes to the water. The chief method of treatment hitherto employed has consisted in the use of small quantities of copper sulphate. Its efficacy varies with the water to be treated; for instance, one part per 1,000,000 by no means destroyed the confervæ present in English lake water. The copper sulphate has also a natural precipitating action varying with different waters from 24 hours to 20 days. The cost of this material is insignificant, the chief outlay being incurred in labour, storage, and the systematic testing of the product for freedom from copper.

The authors then proceeded to discuss the value of the electrolytic hypochlorite for this purpose, pointing out its obvious advantage over a poisonous material like copper. The only permanent addition to the water is a minute quantity of common salt. A series of laboratory experiments were undertaken with an electrolytic solution obtained from the Digby hypochlorite plant; the solution provided, besides having the advantage of cheapness, contained but little undecomposed sodium chloride, so that the final addition of chloride to the treated water is very small. Experiments were made both on the lake water from St. James's Park, and on London tap water infected with various algæ. In each case it was found that a green growth could be entirely prevented by the use of electrolytic chlorine. Different microscopic plants required varying amounts of chlorine, confervæ being most susceptible to treatment. Indeed the quantity of available chlorine just in excess of that immediately consumed by the water inhibited confervoid growth, while half the average chlorine consumed "decidedly retarded growth." On the other hand, desmids required an excess of 0·5 part per million, and diatoms required one part per million in excess. Comparing copper sulphate and available chlorine on lake water, it was found that the use of 1 part per million of copper sulphate was not equal to the use of 1·2 parts (0·2 in excess) of chlorine per million. So far as purposely infected London drinking water is concerned, confervoid growth was prevented by 0·44 part per million of available chlorine. "Practically the only alteration in the chemical analysis is a reduction of the oxygen consumed figure, and an increase in the chloride from 2·1 to 2·4 parts per 100,000."